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OPERATING INSTRUCTIONS FOR

# Model Ultra Trace 3000 Oxygen Analyzer



## DANGER



HIGHLY TOXIC AND OR FLAMMABLE LIQUIDS OR GASES MAY BE PRESENT IN THIS MONITORING SYSTEM.

PERSONAL PROTECTIVE EQUIPMENT MAY BE REQUIRED WHEN SERVICING THIS SYSTEM.

HAZARDOUS VOLTAGES EXIST ON CERTAIN COMPONENTS INTERNALLY WHICH MAY PERSIST FOR A TIME EVEN AFTER THE POWER IS TURNED OFF AND DISCONNECTED.

ONLY AUTHORIZED PERSONNEL SHOULD CONDUCT MAINTENANCE AND/OR SERVICING. BEFORE CONDUCTING ANY MAINTENANCE OR SERVICING CONSULT WITH AUTHORIZED SUPERVISOR/MANAGER.

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### Specific Model Information

The instrument for which this manual was supplied may incorporate one or more options not supplied in the standard instrument. Commonly available options are listed below, with check boxes. Any that are incorporated in the instrument for which this manual is supplied are indicated by a check mark in the box.

**Instrument Serial Number:** \_\_\_\_\_

#### Options Included in the Instrument with the Above Serial Number:

- Ultra Trace 3000-V:** Instrument configured for Vacuum Service
- 19" Rack Mnt:** The 19" Relay Rack Mount units are available with one Ultra Trace 3000 series analyzers installed in a standard 19" panel and ready to mount in a standard rack.

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**This is a general purpose instrument designed for use in a nonhazardous area. It is the customer's responsibility to ensure safety especially when combustible gases are being analyzed since the potential of gas leaks always exist.**

**The customer should ensure that the principles of operation of this equipment is well understood by the user. Misuse of this product in any manner, tampering with its components, or unauthorized substitution of any component may adversely affect the safety of this instrument.**

**Since the use of this instrument is beyond the control of Teledyne, no responsibility by Teledyne, its affiliates, and agents for damage or injury from misuse or neglect of this equipment is implied or assumed.**

## **Introduction**

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### **1.1 Overview**

The Teledyne Analytical Instruments Model 3000 Ultra Trace Oxygen Analyzer is a versatile microprocessor-based instrument for detecting oxygen at the parts-per-billion (ppb) level in a variety of gases. This manual covers the Model Ultra Trace 3000 General Purpose flush-panel and/or rack-mount units only. These units are for indoor use in a nonhazardous environment.

### **1.2 Typical Applications**

A few typical applications of the Model Ultra Trace 3000 are:

- Monitoring inert gas blanketing
- Air separation and liquefaction
- Chemical reaction monitoring
- Semiconductor manufacturing
- Petrochemical process control
- Quality assurance
- Gas analysis certification.

### **1.3 Main Features of the Analyzer**

The Model 3000 Ultra Trace Oxygen Analyzer is sophisticated yet simple to use. The main features of the analyzer include:

- A 2-line alphanumeric vacuum fluorescent display (VFD) screen, driven by microprocessor electronics, that continuously prompts and informs the operator.
- High resolution, accurate readings of oxygen content from low ppm levels through 25%. Large, bright, meter readout.
- Stainless steel cell block (wetted surfaces).

- Advanced Micro-Fuel Cell, designed for trace analysis, has a 0-250 ppb low range with less than a 100 ppb offset and six months warranty and an expected lifetime of one year.
- Versatile analysis over a wide range of applications.
- Microprocessor based electronics: 8-bit CMOS microprocessor with 32 kB RAM and 128 kB ROM.
- Three user definable output ranges (from 0-250 ppb through 0-1000 ppm) allow best match to users process and equipment, plus a fixed 1000 ppm over range.
- Auto Ranging allows analyzer to automatically select the proper preset range for a given measurement. Manual override allows the user to lock onto a specific range of interest.
- Two adjustable concentration alarms and a system failure alarm.
- Extensive self-diagnostic testing, at startup and on demand, with continuous power-supply monitoring.
- Two way RFI protection.
- RS-232 serial digital port for use with a computer or other digital communication device.
- Four analog outputs: two for measurement (0–1 V dc and Isolated 4–20 mA dc) and two for range identification.
- Convenient and versatile, steel, flush-panel or rack-mountable case with slide-out electronics drawer.

## 1.4 Model Designations

**Ultra Trace 3000:** Standard model for sample under pressure

**Ultra Trace 3000-V:** Instrument configured for Vacuum Service



## 1.5 Front Panel (Operator Interface)

The standard Ultra Trace 3000 is housed in a rugged metal case with all controls and displays accessible from the front panel. See Figure 1-1. The front panel has thirteen buttons for operating the analyzer, a digital meter, an alphanumeric display, and a window for viewing the sample flowmeter.

**Function Keys:** Six touch-sensitive membrane switches are used to change the specific function performed by the analyzer:

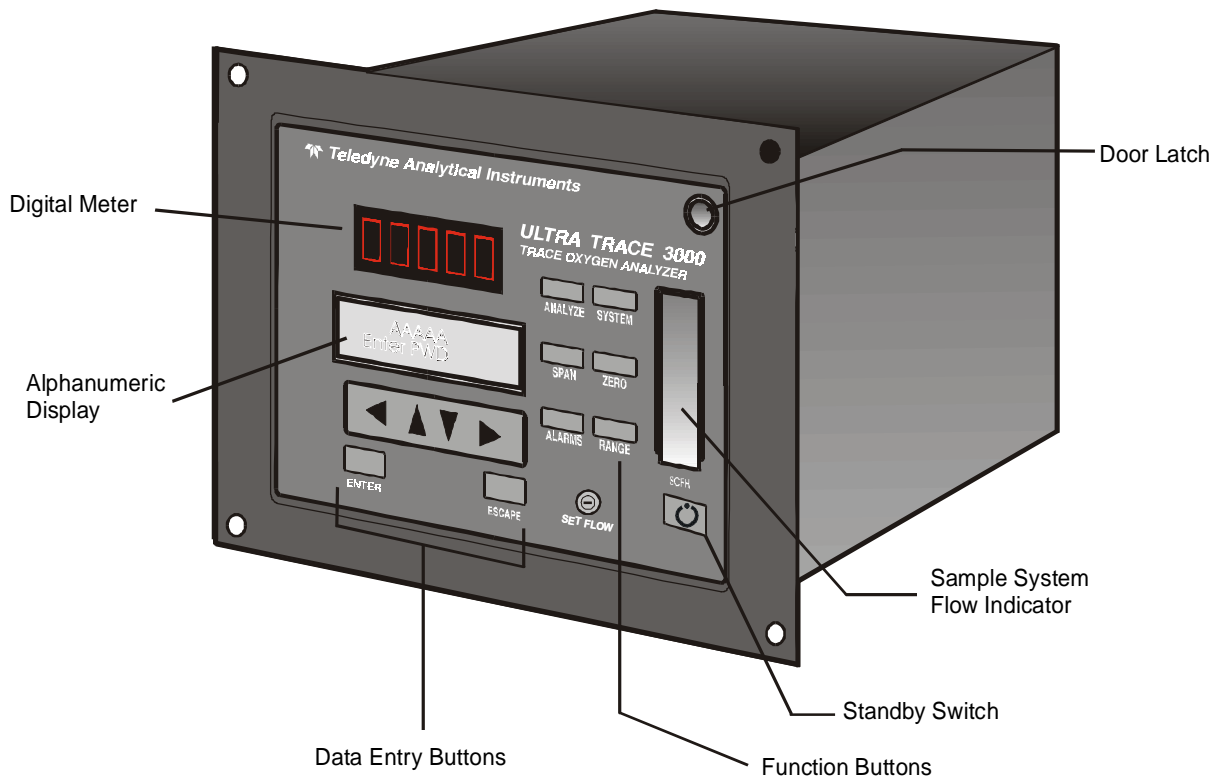


Figure 1-1: Model Ultra Trace 3000 Front Panel

- **Analyze** Perform analysis for oxygen content of a sample gas.
- **System** Perform system-related tasks (described in detail in chapter 4, *Operation*).
- **Span** Span calibrate the analyzer.
- **Zero** Zero calibrate the analyzer.

- **Alarms** Set the alarm setpoints and attributes.
- **Range** Set up the 3 user definable ranges for the instrument.

**Data Entry Keys:** Six touch-sensitive membrane switches are used to input data to the instrument via the alphanumeric VFD display:

- **Left & Right Arrows** Select between functions currently displayed on the VFD screen.
- **Up & Down Arrows** Increment or decrement values of functions currently displayed.
- **Enter** Moves VFD display on to the next screen in a series. If none remains, returns to the *Analyze* screen.
- **Escape** Moves VFD display back to the previous screen in a series. If none remains, returns to the *Analyze* screen.

**Digital Meter Display:** The meter display is a Light Emitting Diode (LED) device that produces large, bright, 7-segment numbers that are legible in any lighting. It produces a continuous readout from 0-999 ppb and then switches to a continuous ppm readout from 0-9999.9 ppm. It is accurate across all analysis ranges without the discontinuity inherent in analog range switching.

**Alphanumeric Interface Screen:** The VFD screen is an easy-to-use interface from operator to analyzer. It displays values, options, and messages that give the operator immediate feedback.

**Needle Valve:** To adjust flow of gas sample

**Flowmeter:** Monitors the flow of gas past the sensor. Readout is 0.2 to 2.4 standard liters per minute (SLPM) of nitrogen

 **Standby Button:** The *Standby* turns off the display and outputs, but circuitry is still operating.

**CAUTION:** *The power cable must be unplugged to fully disconnect power from the instrument. When chassis is exposed or when access door is open and power cable is connected, use extra care to avoid contact with live electrical circuits .*

**Access Door:** For access to the Micro-Fuel Cell, the front panel swings open when the latch in the upper right corner of the panel is pressed

all the way in with a narrow gauge tool. Accessing the main circuit board requires unfastening rear panel screws and sliding the unit out of the case.

## 1.6 Rear Panel (Equipment Interface)

The rear panel, shown in Figure 1-2, contains the gas and electrical connectors for external inlets and outlets. Some of those depicted are optional and may not appear on your instrument. The connectors are described briefly here and in detail in chapter 3 *Installation*.

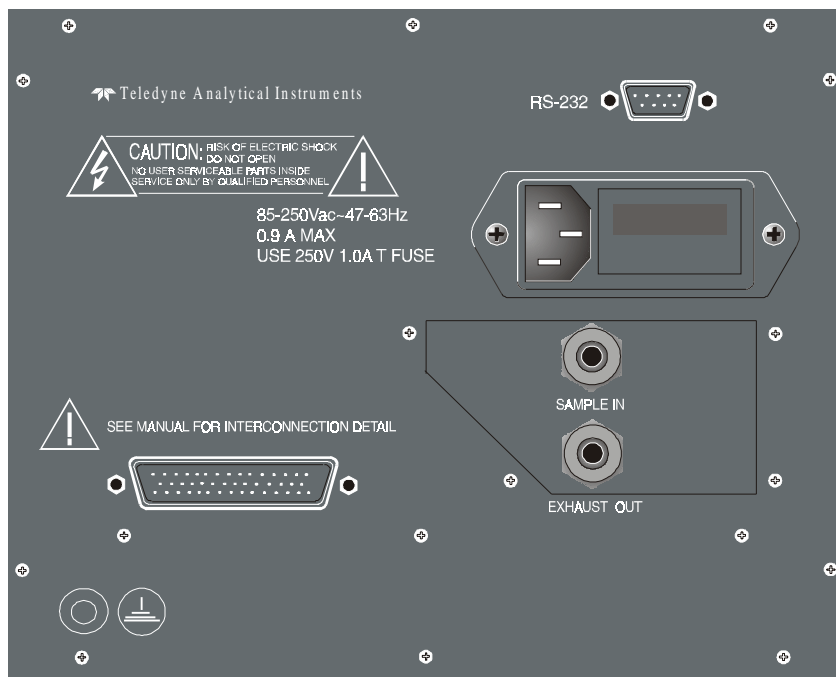


Figure 1-2: Model Ultra Trace 3000 Rear Panel

- **Power Connection** Universal AC power source.
- **Gas Inlet and Outlet** One inlet and one exhaust out.
- **Analog Outputs** 0–1 V dc oxygen concentration plus 0–1 V dc range ID, and isolated 4–20 mA dc oxygen concentration plus 4–20 mA dc range ID.
- **Alarm Connections** 2 concentration alarms and 1 system alarm.

- **RS-232 Port** Serial digital concentration signal output and control input.
- **Remote Probe** Used in the Ultra Trace3000 for controlling external solenoid valves only.
- **Remote Span/Zero** Digital inputs allow external control of analyzer calibration.
- **Calibration Contact** To notify external equipment that instrument is being calibrated and readings are not monitoring sample.
- **Range ID Contacts** Four separate, dedicated, range relay contacts. Low, Medium, High, Cal.
- **Network I/O** Serial digital communications for local network access. For future expansion. Not implemented at this printing.

**Note:** If you require highly accurate Auto-Cal timing, use external Auto-Cal control where possible. The internal clock in the Model Ultra Trace 3000 is accurate to 2-3 %. Accordingly, internally scheduled calibrations can vary 2-3 % per day.

## **Operational Theory**

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### **2.1 Introduction**

The analyzer is composed of three subsystems:

1. Micro-fuel Cell Sensor
2. Sample System
3. Electronic Signal Processing, Display and Control

The sample system is designed to accept the sample gas and transport it through the analyzer without contaminating or altering the sample prior to analysis. The Micro-fuel Cell is an electrochemical galvanic device that translates the amount of oxygen present in the sample into an electrical current. The electronic signal processing, display and control subsystem simplifies operation of the analyzer and accurately processes the sampled data. The microprocessor controls all signal processing, input/output and display functions for the analyzer.

### **2.2 Micro-Fuel Cell Sensor**

#### **2.2.1 Principles of Operation**

The oxygen sensor used in the Model Ultra Trace 3000 series is a Micro-fuel Cell, Model B-2CXL designed and manufactured by Analytical Instruments. It is a sealed plastic disposable electrochemical transducer.

The active components of the Micro-fuel Cell are a cathode, an anode, and the aqueous KOH electrolyte in which they are immersed. The cell converts the energy from a chemical reaction into an electrical current in an external electrical circuit. Its action is similar to that of a battery.

There is, however, an important difference in the operation of a battery as compared to the Micro-fuel Cell: In the battery, all reactants are stored within the cell, whereas in the Micro-fuel Cell, one of the reactants (oxygen)

comes from outside the device as a constituent of the sample gas being analyzed. The Micro-Fuel Cell is therefore a hybrid between a battery and a true fuel cell. (All of the reactants are stored externally in a true fuel cell.)

### 2.2.2 Anatomy of a Micro-Fuel Cell

The Micro-Fuel Cell is a cylinder only 1¼ inches in diameter and 1¼ inches thick. It is made of an extremely inert plastic, which can be placed confidently in practically any environment or sample stream. It is effectively sealed, although one end is permeable to oxygen in the sample gas. The other end of the cell is a contact plate consisting of two concentric foil rings. The rings mate with spring-loaded contacts in the sensor block assembly and provide the electrical connection to the rest of the analyzer. Figure 2-1 illustrates the external features.

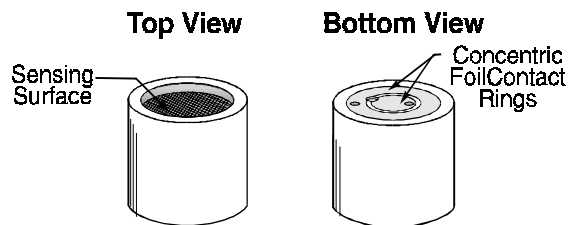


Figure 2-1: Micro-fuel Cell

Refer to Figure 2-2, *Cross Section of a Micro-Fuel Cell*, which illustrates the following internal description.

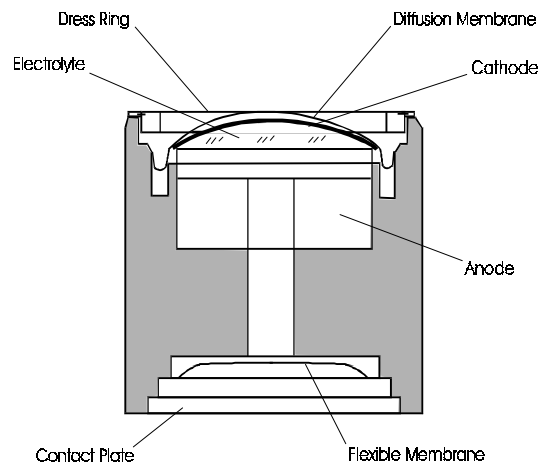


Figure 2-2. Cross Section of a Micro-Fuel Cell (not to scale)

At the top end of the cell is a diffusion membrane of Teflon, whose thickness is very accurately controlled. Beneath the diffusion membrane lies

the oxygen sensing element—the cathode—with a surface area almost 4 cm<sup>2</sup>. The cathode has many perforations to ensure sufficient wetting of the upper surface with electrolyte, and it is plated with an inert metal.

The anode structure is below the cathode. It is made of lead and has a proprietary design which is meant to maximize the amount of metal available for chemical reaction.

At the rear of the cell, just below the anode structure, is a flexible membrane designed to accommodate the internal volume changes that occur throughout the life of the cell. This flexibility assures that the sensing membrane remains in its proper position, keeping the electrical output constant.

The entire space between the diffusion membrane, above the cathode, and the flexible rear membrane, beneath the anode, is filled with electrolyte. Cathode and anode are submerged in this common pool. They each have a conductor connecting them to one of the external contact rings on the contact plate, which is on the bottom of the cell.

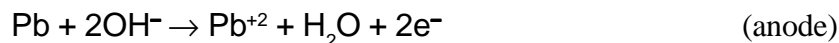
### 2.2.3 Electrochemical Reactions

The sample gas diffuses through the Teflon membrane. Any oxygen in the sample gas is reduced on the surface of the cathode by the following HALF REACTION:



(Four electrons combine with one oxygen molecule—in the presence of water from the electrolyte—to produce four hydroxyl ions.)

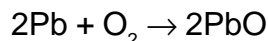
When the oxygen is reduced at the cathode, lead is simultaneously oxidized at the anode by the following HALF REACTION:



(Two electrons are transferred for each atom of lead that is oxidized. Therefore it takes two of the above anode reactions to balance one cathode reaction and transfer four electrons.)

The electrons released at the surface of the anode flow to the cathode surface when an external electrical path is provided. The current is proportional to the amount of oxygen reaching the cathode. It is measured and used to determine the oxygen concentration in the gas mixture.

The overall reaction for the fuel cell is the SUM of the half reactions above, or:



(These reactions are specific to oxygen as long as no gaseous components capable of oxidizing lead—such as iodine, bromine, chlorine and fluorine—are present in the sample.)

In the absence of oxygen, no current is generated.

### 2.2.4 The Effect of Pressure

In order to state the amount of oxygen present in the sample in ppb or parts-per-million of the gas mixture, it is necessary that the sample diffuse into the cell under constant pressure.

If the total pressure increases, the rate that oxygen reaches the cathode through the diffusing membrane will also increase. The electron transfer, and therefore the external current, will increase, even though the oxygen concentration of the sample has not changed. It is therefore important that the sample pressure at the fuel cell (usually vent pressure) remain relatively constant between calibrations.

### 2.2.5 Calibration Characteristics

Given that the total pressure of the sample gas on the surface of the Micro-Fuel Cell input is constant, a convenient characteristic of the cell is that the current produced in an external circuit is directly proportional to the rate at which oxygen molecules reach the cathode, and this rate is directly proportional to the concentration of oxygen in the gaseous mixture. In other words it has a linear characteristic curve, as shown in Figure 2-3. Measuring circuits do not have to compensate for nonlinearities.

In addition, since there is zero output in the absence of oxygen, the characteristic curve has close to an absolute zero (less than  $\pm 0.1$  ppm oxygen). Depending upon the application, zeroing may still be used to compensate for the combined zero offsets of the cell and the electronics.

### 2.2.6 TEC Cooling System

Ultra Trace 3000 analyzers include an advance Thermal Electric Cooler (TEC) system. This system enhances the performance of the Micro-fuel Cell by cooling it and regulating its operating temperature. The TEC system includes a TEC module, a temperature control PCB, a separate power supply, a thermistor, and a special insulated cellblock. The system is used to regulate the cell temperature at 11 degrees C. Operating the Micro-fuel Cell at a low



temperature minimizes the cell offset (typically less than 75 PPB). A second benefit of the TEC system is that by regulating the cell temperature the analyzer becomes tolerant of thermal transients.

The TEC module is a solid-state semiconductor heat – pump. Passing DC current through the TEC module produces heat flow through the device. One side of the device will become hot and the other side will become cold. The TEC module is attached to a heat-sink which is cooled by a fan. This is required to maintain the hot side at an acceptable temperature. The hot side temperature limits the overall performance of the TEC module. The fan draws air into the bottom of the analyzer, this air is forced over the heat sink and exits through the left side of the analyzer. The power for the TEC device is supplied by a Pulse Width Modulated (PWM) proportional switching temperature controller. The temperature controller PCB supplies a 12 volt pulse whose duty cycle is proportional to the cooling required. The temperature controller PCB uses a thermistor to monitor the temperature of the cell block. Power for the fan, and the temperature controller PCB is supplied by a separate 12VDC power supply.

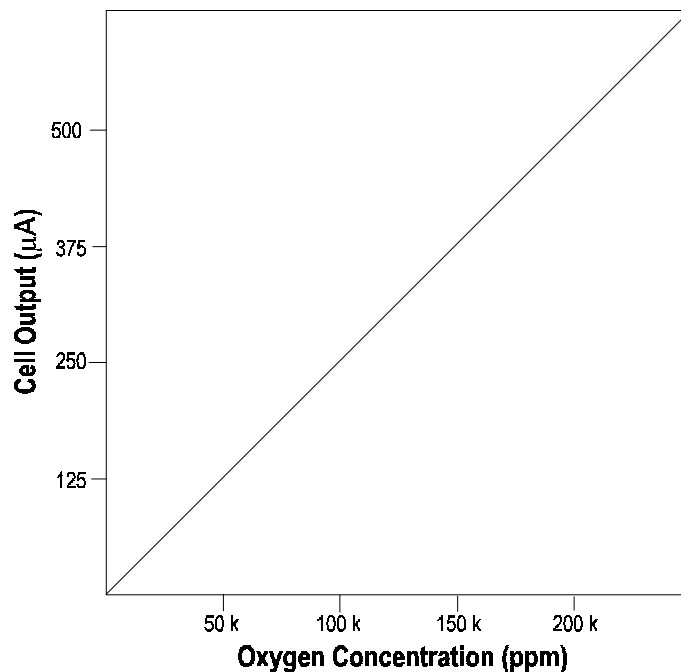


Figure 2-3. Characteristic Input/Output Curve for a Micro-Fuel Cell

### 2.3 Sample System

The sample system delivers gases to the Micro-Fuel Cell sensor from the analyzer rear panel inlet. Depending on the mode of operation either sample or calibration gas is delivered.

The Model Ultra Trace 3000 sample system is designed and fabricated to ensure that the oxygen concentration of the gas is not altered as it travels through the sample system.

The sample system for the standard instrument incorporates 1/4" VCR for sample inlet and outlet tube connections at the rear panel. The sample or calibration gas that flows through the system is monitored by a flowmeter downstream from the cell. Figure 2-4 shows the piping layout and flow diagram for the standard model.

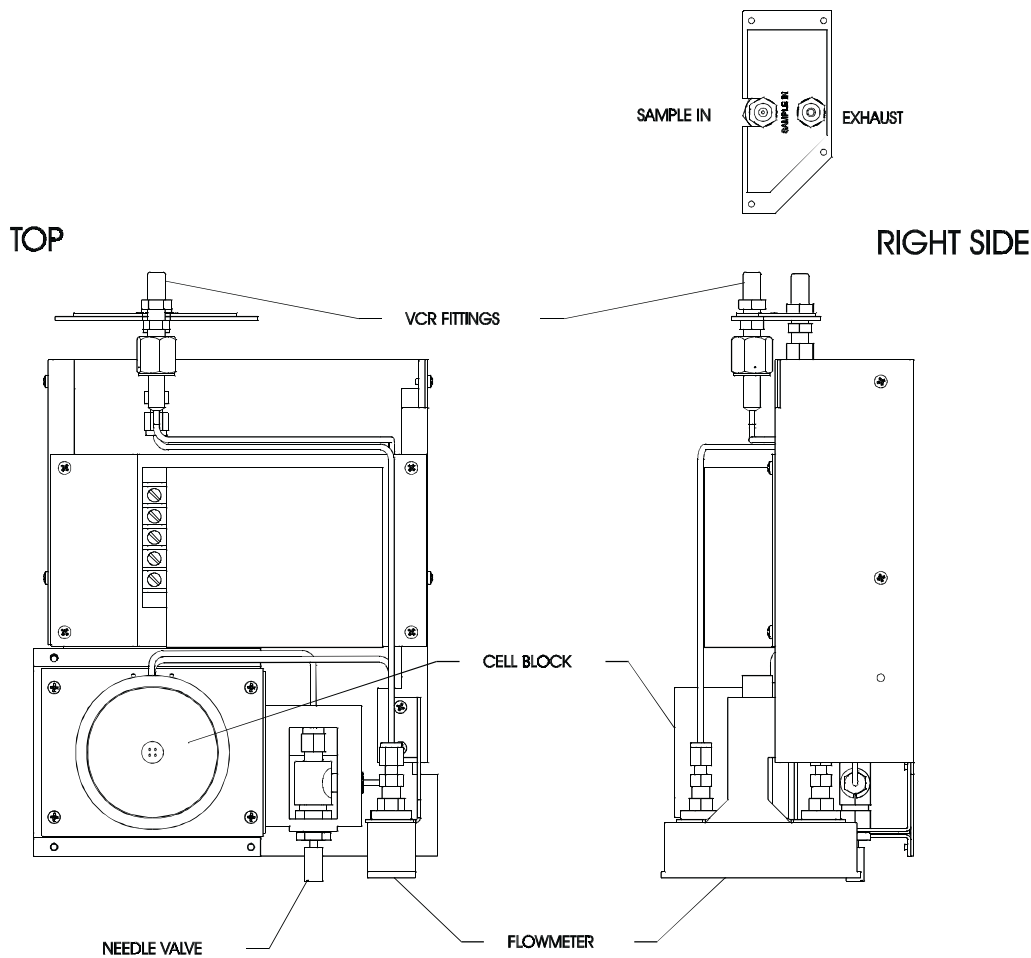


Figure 2-4: Piping Layout

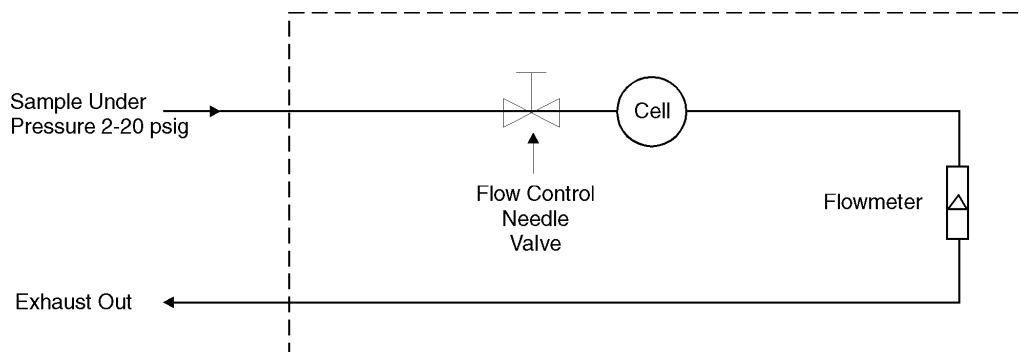


Figure 2-5: Flow Diagram-Sample Under Pressure  
 -Standard Model Ultra Trace 3000

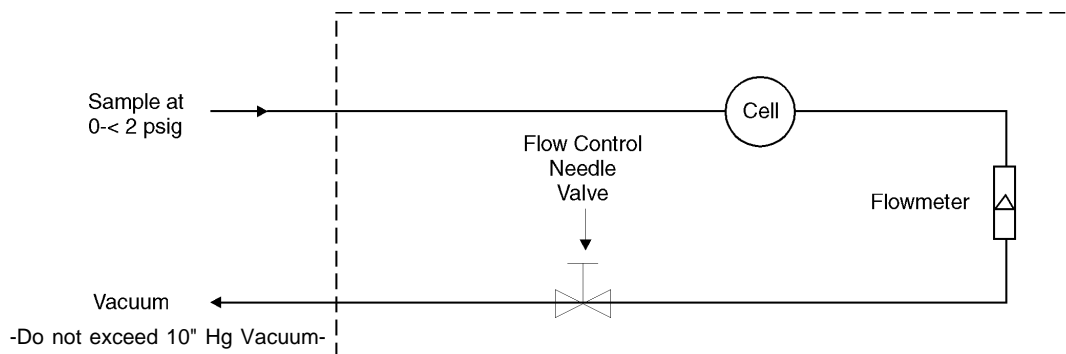


Figure 2-5-1: Flow Diagram-Sample at Zero Pressure  
 -Model Ultra Trace 3000-V

Figure 2-5 is the flow diagram for the sampling system. In the standard instrument, calibration gases can be connected directly to the Sample In port by teeing to the port with appropriate valves.

## 2.4 Electronics and Signal Processing

The Model Ultra Trace 3000 Oxygen Analyzer uses an 8031 microcontroller with 32 kB of RAM and 128 kB of ROM to control all signal processing, input/output, and display functions for the analyzer. System power is supplied from a universal power supply module designed to be compatible with any international power source. Figure 2-6 shows the location of the power supply and the main electronic PC boards.

The signal processing electronics including the microprocessor, analog to digital, and digital to analog converters are located on the motherboard at the bottom of the case. The preamplifier board is mounted on top of the motherboard as shown in the figure. These boards are accessible after removing the back panel. Figure 2-7 is a block diagram of the Analyzer electronics.

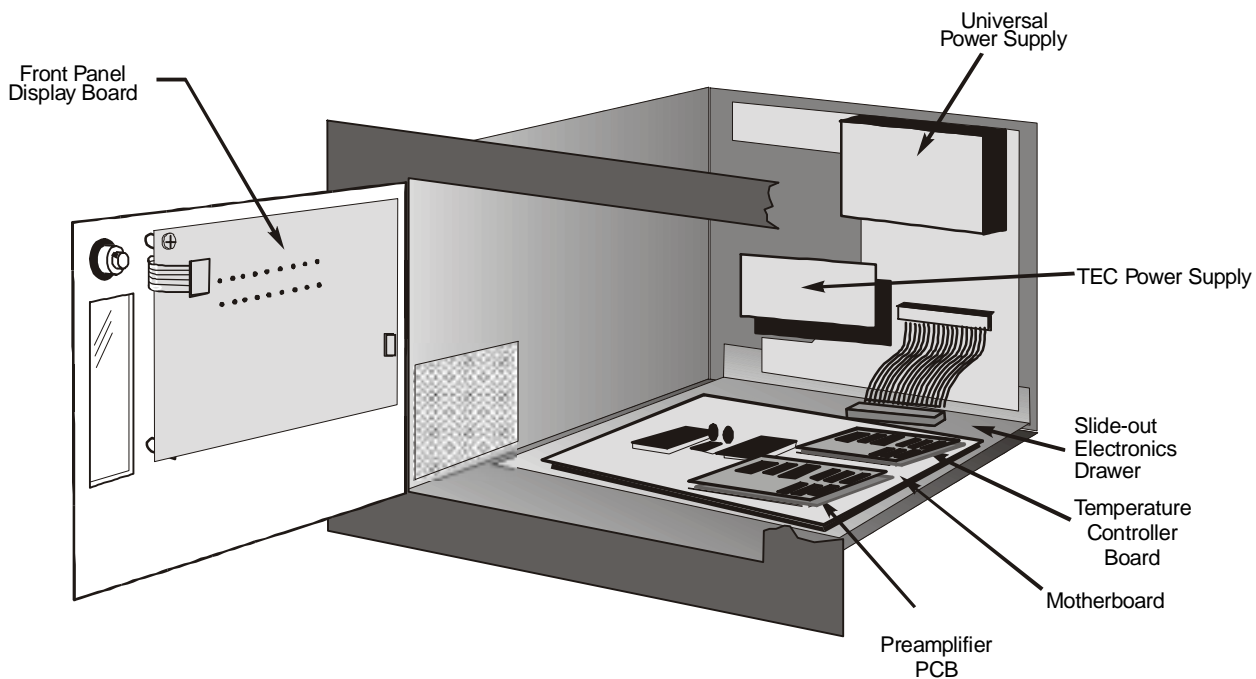


Figure 2-6: Electronic Component Location Inside the Model Ultra Trace 3000

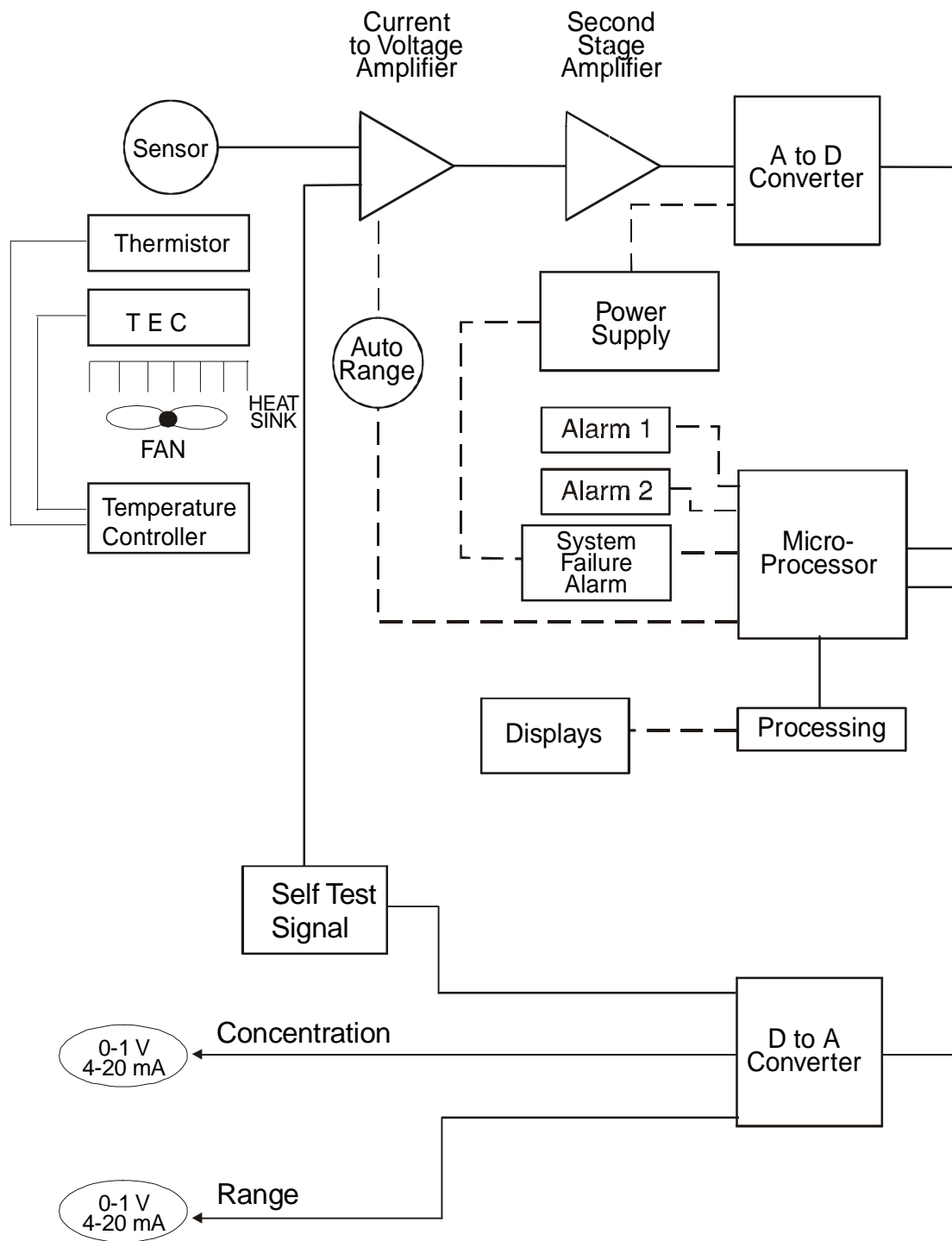


Figure 2-7: Block Diagram of the Model Ultra Trace 3000 Electronics

In the presence of oxygen the cell generates a current. A current to voltage amplifier converts this current to a voltage, which is further amplified in the second stage amplifier.

The output from the second stage amplifier is sent to an 18 bit analog to digital converter controlled by the microprocessor.

The digital concentration signal along with input from the control panel is processed by the microprocessor, and appropriate control signals are directed to the display, alarms and communications port. The same digital information is also sent to a 12 bit digital to analog converter that produces the 4-20 mA dc and the 0-1 V dc analog concentration signal outputs, and the analog range ID outputs.

Signals from the power supply are also monitored, and through the microprocessor, the system failure alarm is activated if a malfunction is detected.

## **Installation**

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Installation of the Model Ultra Trace 3000 Analyzer includes:

1. Unpacking
2. Mounting
3. Gas connections
4. Electrical connections
5. Installing the Micro-Fuel Cell
6. Testing the system.

### **3.1 Unpacking the Analyzer**

Although the analyzer is shipped complete, certain of the parts, such as fuses and sensors, are wrapped separately to be installed on site as part of the installation. Carefully unpack the analyzer and inspect it for damage. Immediately report any damage or shortages to the shipping agent.

### **3.2 Mounting the Analyzer**

The Model Ultra Trace 3000 is for indoor use in a general purpose area. It is NOT for hazardous environments of any type.

The standard model is designed for flush panel mounting. Figure 3-1 is an illustration of the Ultra Trace 3000 standard front panel and mounting bezel. There are four mounting holes—one in each corner of the rigid frame. The drawings section in the rear of this manual contains outline dimensions and mounting hole spacing diagrams.

On special order, a 19" rack-mounting panel can be provided. For rack mounting, one Ultra Trace 3000 series analyzer is flush-panel mounted on the rack panel. See Appendix for dimensions of the mounting panel.

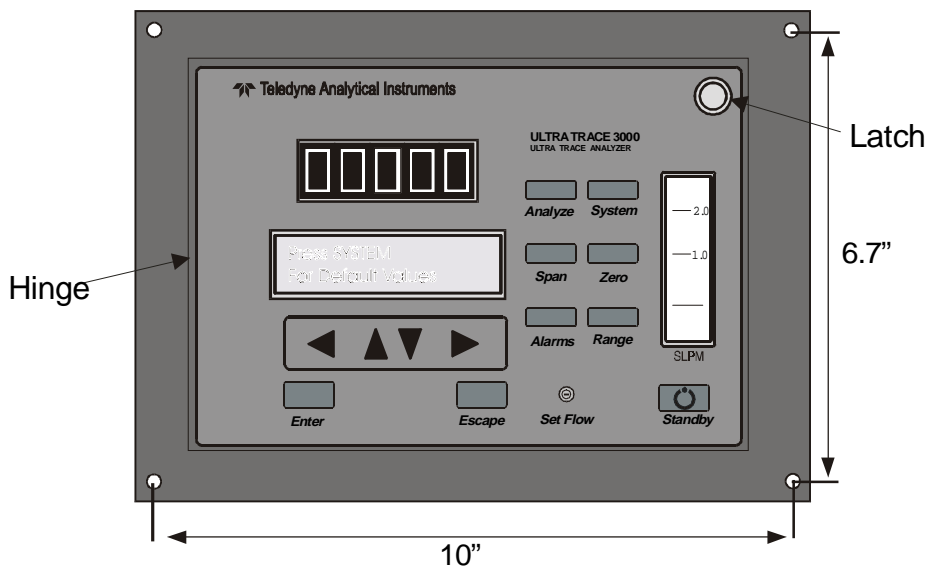


Figure 3-1: Front Panel of the Model Ultra Trace 3000

All operator controls are mounted on the control panel, which is hinged on the left edge and doubles as the door that provides access to the sensor and cell block inside the instrument. The door is spring loaded and will swing open when the button in the center of the latch (upper right corner) is pressed all the way in with a narrow gauge tool (less than 0.18 inch wide), such as a small hex wrench or screwdriver. Allow clearance for the door to open in a 90-degree arc of radius 7.125 inches. See Figure 3-2.

Provide 1 inch of air clearance at the bottom and sides of the instrument for proper air flow for TEC fun.

**Failure to provide such a clearance will cause damage to the TEC system. Do not restrict this openings.**

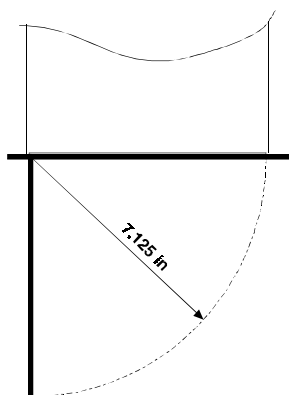
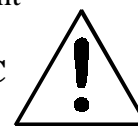


Figure 3-2: Required Front Door Clearance



### 3.3 Rear Panel Connections

Figure 3-3 shows the Model Ultra Trace 3000 rear panel. There are ports for gas inlet and outlet, power, communication, and both digital and analog concentration output.

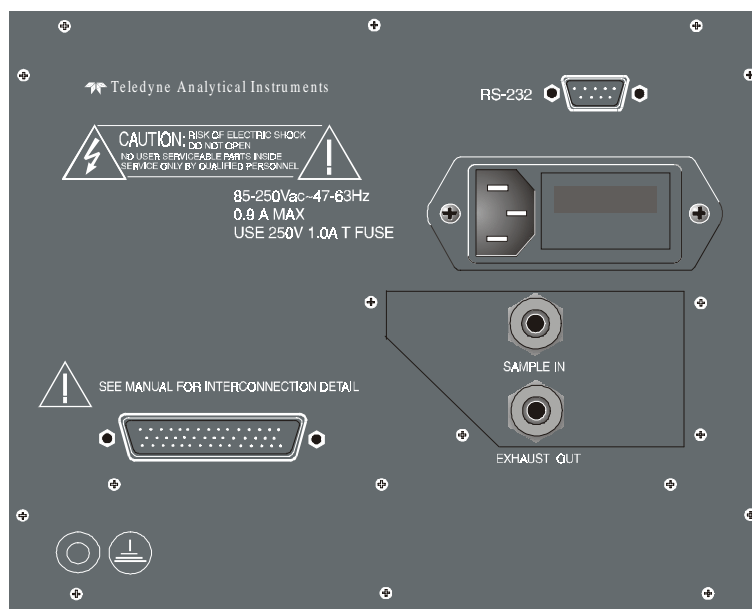


Figure 3-3: Rear Panel of the Model Ultra Trace 3000

#### 3.3.1 Gas Connections

The unit is manufactured with  $\frac{1}{4}$  inch VCR fittings. For a safe connection:

**SAMPLE IN:** In the standard model, gas connections are made at the SAMPLE IN and EXHAUST OUT connections. Calibration gases must be Tee'd into the Sample inlet with appropriate valves. A VCR fitting is provided for the inlet connection.

The inlet gas pressure should be reasonably regulated. Pressures between 1 and 50 psig are acceptable as long as the pressure, once established, will keep the front panel flowmeter reading in an acceptable range (0.5 to 2.0 SLPM). For non-pressurized sample or very low pressure, (less than 1 psig) vacuum service plumbing is recommended. (See next section: Vacuum Service).

If greater sample flow is required for improved response time, install a bypass in the sampling system upstream of the analyzer input.

**VACUUM SERVICE:** If the sample pressure is at atmospheric or very low pressure, the instrument must be ordered with the vacuum service option. This will ensure that the flow control valve is located on the exhaust side of the Micro-Fuel Cell.

**EXHAUST OUT:** Exhaust connections must be consistent with the hazard level of the constituent gases. Check Local, State, and Federal laws, and ensure that the exhaust stream vents to an appropriately controlled area, if required.

### 3.3.2 Electrical Connections


For safe connections, no uninsulated wiring should be able to come in contact with fingers, tools or clothing during normal operation.

**CAUTION:** *Use Shielded Cables. Also, use plugs that provide excellent EMI/RFI protection. The plug case must be connected to the cable shield, and it must be tightly fastened to the analyzer with its fastening screws. Ultimately, it is the installer who ensures that the connections provide adequate EMI/RFI shielding.*



#### 3.3.2.1 Primary Input Power

The power cord receptacle and fuse block are located in the same assembly. Insert the power cord into the power cord receptacle.

**CAUTION:** *Power is applied to the instrument's circuitry as long as the instrument is connected to the power source. The red  switch on the front panel is for switching power on or off to the displays and outputs only.*



The universal power supply requires a 85–250 V ac, 47–63 Hz power source.

**Fuse Installation:** The fuse block, at the right of the power cord receptacle, accepts US or European size fuses. A jumper replaces the fuse in whichever fuse receptacle is not used. Fuses are not installed at the factory. Be sure to install the proper fuse as part of installation. (See *Fuse Replacement* in chapter 5, *maintenance*.)

### 3.3.2.2 50-Pin Equipment Interface Connector

Figure 3-4 shows the pin layout of the Equipment Interface connector. The arrangement is shown as seen when the viewer faces the rear panel of the analyzer. The pin numbers for each input/output function are given where each function is described in the paragraphs below.

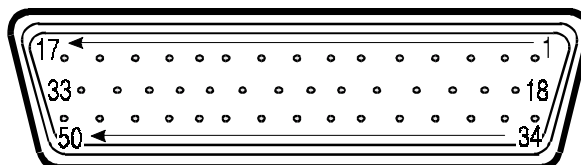


Figure 3-4: Equipment Interface Connector Pin Arrangement

**Analog Outputs:** There are four DC output signal pins—two pins per output. For polarity, see Table 3-1. The outputs are:

- 0–1 V dc % of Range: Voltage rises linearly with increasing oxygen, from 0 V at 0 ppm to 1 V at full scale ppm. (Full scale = 100% of programmable range.)
- 0–1 V dc Range ID: 0.25 V = Low Range, 0.5 V = Medium Range, 0.75 V = High Range, 1 V = Air Cal Range.
- 4–20 mA dc % Range: Current increases linearly with increasing oxygen, from 4 mA at 0 ppm to 20 mA at full scale ppm. (Full scale = 100% of programmable range.)
- 4–20 mA dc Range ID: 8 mA = Low Range, 12 mA = Medium Range, 16 mA = High Range, 20 mA = Air Cal Range.



Table 3-1: Analog Output Connections

Pin	Function
3	+ Range ID, 4-20 mA, floating
4	– Range ID, 4-20 mA, floating
5	+ % Range, 4-20 mA, floating
6	– % Range, 4-20 mA, floating
8	+ Range ID, 0-1 V dc
23	– Range ID, 0-1 V dc, negative ground
24	+ % Range, 0-1 V dc
7	– % Range, 0-1 V dc, negative ground

**Alarm Relays:** The nine alarm-circuit connector pins connect to the internal alarm relay contacts. Each set of three pins provides one set of Form C relay contacts. Each relay has both normally open and normally closed

contact connections. The contact connections are shown in Table 3-2. They are capable of switching up to 3 amperes at 250 V ac into a resistive load.

The connectors are:

- Threshold Alarm 1:
- Can be configured as high (actuates when concentration is above threshold), or low (actuates when concentration is below threshold).
  - Can be configured as failsafe or nonfailsafe.
  - Can be configured as latching or nonlatching.
  - Can be configured out (defeated).
- Threshold Alarm 2:
- Can be configured as high (actuates when concentration is above threshold), or low (actuates when concentration is below threshold).
  - Can be configured as failsafe or nonfailsafe.
  - Can be configured as latching or nonlatching.
  - Can be configured out (defeated).
- System Alarm:
- Actuates when DC power supplied to circuits is unacceptable in one or more parameters. Permanently configured as failsafe and latching. Cannot be defeated. Actuates if self test fails.
- (Reset by pressing  button to remove power. Then press  again and any other button EXCEPT *System* to resume.

Further detail can be found in chapter 4, section 4-5.

**Table 3-2: Alarm Relay Contact Pins**

**Pin Contact**

45	Threshold Alarm 1, normally closed contact
28	Threshold Alarm 1, moving contact
46	Threshold Alarm 1, normally open contact
42	Threshold Alarm 2, normally closed contact
44	Threshold Alarm 2, moving contact
43	Threshold Alarm 2, normally open contact
36	System Alarm, normally closed contact
20	System Alarm, moving contact
37	System Alarm, normally open contact

**Digital Remote Cal Inputs:** Accept 0 V (off) or 24 V dc (on) inputs for remote control of calibration. (See *Remote Calibration Protocol* below.) See Table 3-3 for pin connections.

- Zero:** Floating input. 5 to 24 V input across the + and – pins puts the analyzer into the *Zero* mode. Either side may be grounded at the source of the signal. 0 to 1 volt across the terminals allows *Zero* mode to terminate when done. A synchronous signal must open and close the external zero valve appropriately. See *Remote Probe Connector*. (The –C option internal valves operate automatically.)
- Span:** Floating input. 5 to 24 V input across the + and – pins puts the analyzer into the *Span* mode. Either side may be grounded at the source of the signal. 0 to 1 volt across the terminals allows *Span* mode to terminate when done. A synchronous signal must open and close external span valve appropriately. See Figure 3-5 *Remote Probe Connector*. (The –C option internal valves operate automatically.)

**Cal Contact:** This relay contact is closed while analyzer is spanning and/or zeroing. (See *Remote Calibration Protocol* below.)

**Table 3-3: Remote Calibration Connections**

Pin	Function
9	+ Remote Zero
11	– Remote Zero
10	+ Remote Span
12	– Remote Span
40	Cal Contact
41	Cal Contact

**Remote Calibration Protocol:** To properly time the Digital Remote Cal Inputs to the Model Ultra Trace 3000 Analyzer, the customer's controller must monitor the Cal Relay Contact.

When the contact is OPEN, the analyzer is analyzing, the Remote Cal Inputs are being polled, and a zero or span command can be sent.

When the contact is CLOSED, the analyzer is already calibrating. It will ignore your request to calibrate, and it will not remember that request.

Once a zero or span command is sent, and acknowledged (contact closes), release it. If the command is continued until after the zero or span is complete, the calibration will repeat and the Cal Relay Contact (CRC) will close again.

For example:

- 1) Test the CRC. When the CRC is open, Send a zero command until the CRC closes (The CRC will quickly close.)
- 2) When the CRC closes, remove the zero command.
- 3) When CRC opens again, send a span command until the CRC closes. (The CRC will quickly close.)
- 4) When the CRC closes, remove the span command.

When CRC opens again, zero and span are done, and the sample is being analyzed.

**Note: The Remote Valve connections (described below) provides signals to ensure that the zero and span gas valves will be controlled synchronously.**

**Range ID Relays:** Four dedicated Range ID relay contacts. The first three ranges are assigned to relays in ascending order—Low range is assigned to Range 1 ID, Medium range is assigned to Range 2 ID, and High range is assigned to Range 3 ID. The fourth range is reserved for the Air Cal Range (25%). Table 3-4 lists the pin connections.

**Table 3-4: Range ID Relay Connections**

Pin	Function
21	Range 1 ID Contact
38	Range 1 ID Contact
22	Range 2 ID Contact
39	Range 2 ID Contact
19	Range 3 ID Contact
18	Range 3 ID Contact
34	Range 4 ID Contact (Air Cal)
35	Range 4 ID Contact (Air Cal)

**Network I/O:** A serial digital input/output for local network protocol. At this printing, this port is not yet functional. It is to be used for future options to the instrument. Pins 13 (+) and 29 (-).

**Remote Valve Connections:** The Ultra Trace 3000 is a single-chassis instrument, which has no Remote Valve Unit. Instead, the Remote Valve connections are used as a method for directly controlling external sample/zero/span gas valves. See Figure 3-5.

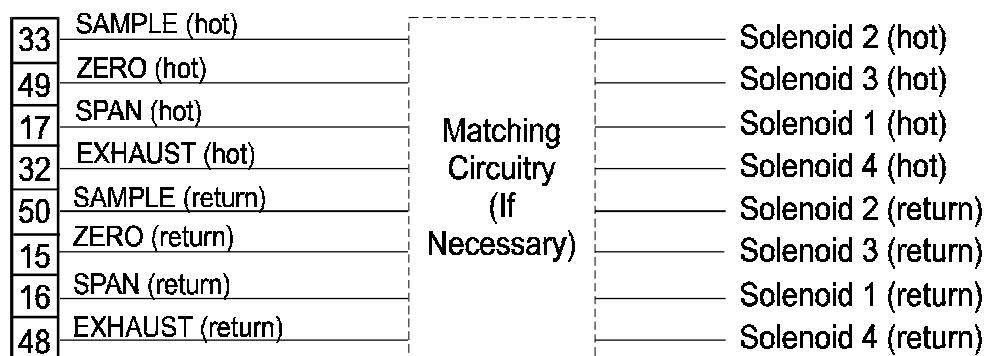


Figure 3-5: Remote Probe Connections

The voltage from these outputs is nominally 0 V for the OFF and 15 V dc for the ON conditions. The maximum combined current that can be pulled from these output lines is 100 mA. (If two lines are ON at the same time, each must be limited to 50 mA, etc.) If more current and/or a different voltage is required, use a relay, power amplifier, or other matching circuitry to provide the actual driving current.

In addition, each individual line has a series FET with a nominal ON resistance of 5 ohms (9 ohms worst case). This can limit the obtainable voltage, depending on the load impedance applied. See Figure 3-6.

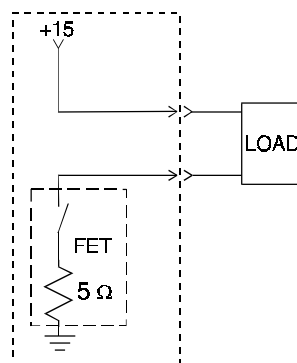


Figure 3-6: FET Series Resistance

### 3.4 Installing the Micro-Fuel Cell

The Micro-Fuel Cell, Model B-2CXL is not installed in the cell block when the instrument is shipped. Install it before the analyzer is placed in service.

The Micro-Fuel cell is located inside the stainless steel cell block behind the front panel (see Figure 3-8). To install the cell:

1. Remove power to the instrument by unplugging the power cord at the power source.
2. Open the front panel door by pressing the release button on the top right corner of the door all the way in with a narrow gauge tool.
3. With one hand hold the top of the cell block while unscrewing the plastic ring holder. Once the plastic ring is loose, remove the top of the cell block.

**CAUTION:**

The cell is shipped separately inside two bags filled with oxygen-free inert gas. Extreme care must be taken to ensure that the cell is exposed to air for the very minimum amount of time, including during installation.

As an example, an air exposure of 3 to 5 minutes may require 24 hours or longer before the cell recovers to less than 0.5 ppm on an oxygen free sample gas. On the other hand, if the air exposure is limited to less than 10 seconds, the recovery time will be reduced to two hours, or less.

### 3.5 Testing the System

Before plugging the instrument into the power source:

- Check the integrity and accuracy of the gas connections. Make sure there are no leaks.
- Check the integrity and accuracy of the electrical connections. Make sure there are no exposed conductors
- Check that inlet sample pressure is within the accepted range (see section 3.3.1).

Power up the system, and test it by performing the following operations:

1. Repeat the Self-Diagnostic Test as described in chapter 4, section 4.3.5.



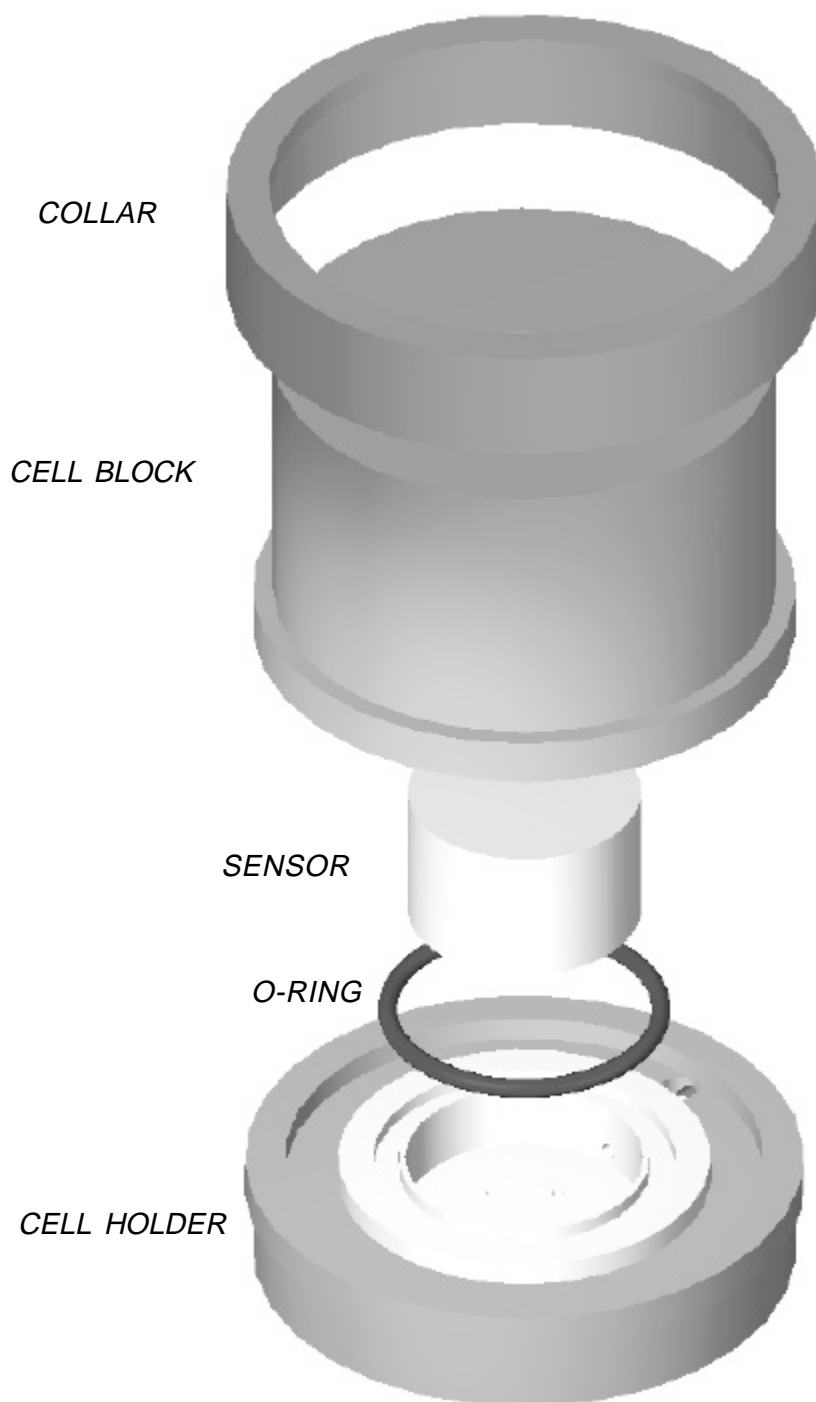


Figure 3-8: Installing the Micro-Fuel Cell

**IMPORTANT:**

In the event of loss of flow through the analyzer, if the vent is vented to a location of high oxygen content, oxygen will back diffuse through the vent line and in most cases quickly saturate the cell with oxygen which can then require a quite long purge down time for the sensor when then exposed to low oxygen concentrations. In the event that flow is to be interrupted into the analyzer, it is suggested that the user do one of the following:

1. Bag the sensor in nitrogen during this time
2. Install a shut off valve on the vent port of the analyzer or somewhere within the users sample system.

---

## Operation

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### 4.1 Introduction

Once the analyzer has been installed, it can be configured for your application. To do this you will:

- Set system parameters:
  - Establish a security password, if desired, requiring Operator to log in.
  - Establish and start an automatic calibration cycle, if desired.
- Calibrate the instrument.
- Define the three user selectable analysis ranges, then choose autoranging or select a fixed range of analysis, as required.
- Set alarm setpoints, and modes of alarm operation (latching, failsafe, etc).

Before you configure your Ultra Trace 3000, these default values are in effect:

**Ranges:** LO = 250ppb ppm, MED = 1 ppm, HI = 10 ppm.

**Auto Ranging:** ON

**Alarm Relays:** Defeated, Alarm 1 at 10.000 ppm, Alarm 2 at 1.000 ppm HI, Not failsafe, Not latching.

**Zero:** Auto, every 0 days at 0 hours.

**Span:** Auto, at 008.00 ppm, every 0 days at 0 hours.

If you choose not to use password protection, the default password is automatically displayed on the password screen when you start up, and you simply press *Enter* for access to all functions of the analyzer.

---

## 4.2 Using the Data Entry and Function Buttons

**Data Entry Buttons:** The < > arrow buttons select options from the menu currently being displayed on the VFD screen. The selected option blinks.

When the selected option includes a modifiable item, the  $\Delta\nabla$  arrow buttons can be used to increment or decrement that modifiable item.

The *Enter* button is used to accept any new entries on the VFD screen. The *Escape* button is used to abort any new entries on the VFD screen that are not yet accepted by use of the *Enter* button.

Figure 4-1 shows the hierarchy of functions available to the operator via the function buttons. The six function buttons on the analyzer are:

- **Analyze.** This is the normal operating mode. The analyzer monitors the oxygen content of the sample, displays the percent of oxygen, and warns of any alarm conditions.
- **System.** The system function consists of six subfunctions that regulate the internal operations of the analyzer:
  - Auto-Cal setup
  - Password assignment
  - Self-Test initiation
  - Checking software version
  - Logging out.
  - Show negative readings
  - Set digital filter
- **Zero.** Used to set up a zero calibration.
- **Span.** Used to set up a span calibration.
- **Alarms.** Used to set the alarm setpoints and determine whether each alarm will be active or defeated, HI or LO acting, latching, and/or failsafe.
- **Range.** Used to set up three analysis ranges that can be switched automatically with auto-ranging or used as individual fixed ranges.

Any function can be selected at any time by pressing the appropriate button (unless password restrictions apply). The order as presented in this manual is appropriate for an initial setup.

Each of these functions is described in greater detail in the following procedures. The VFD screen text that accompanies each operation is reproduced, at the appropriate point in the procedure, in a `Monospaced` type style. Pushbutton names are printed in *Oblique* type.

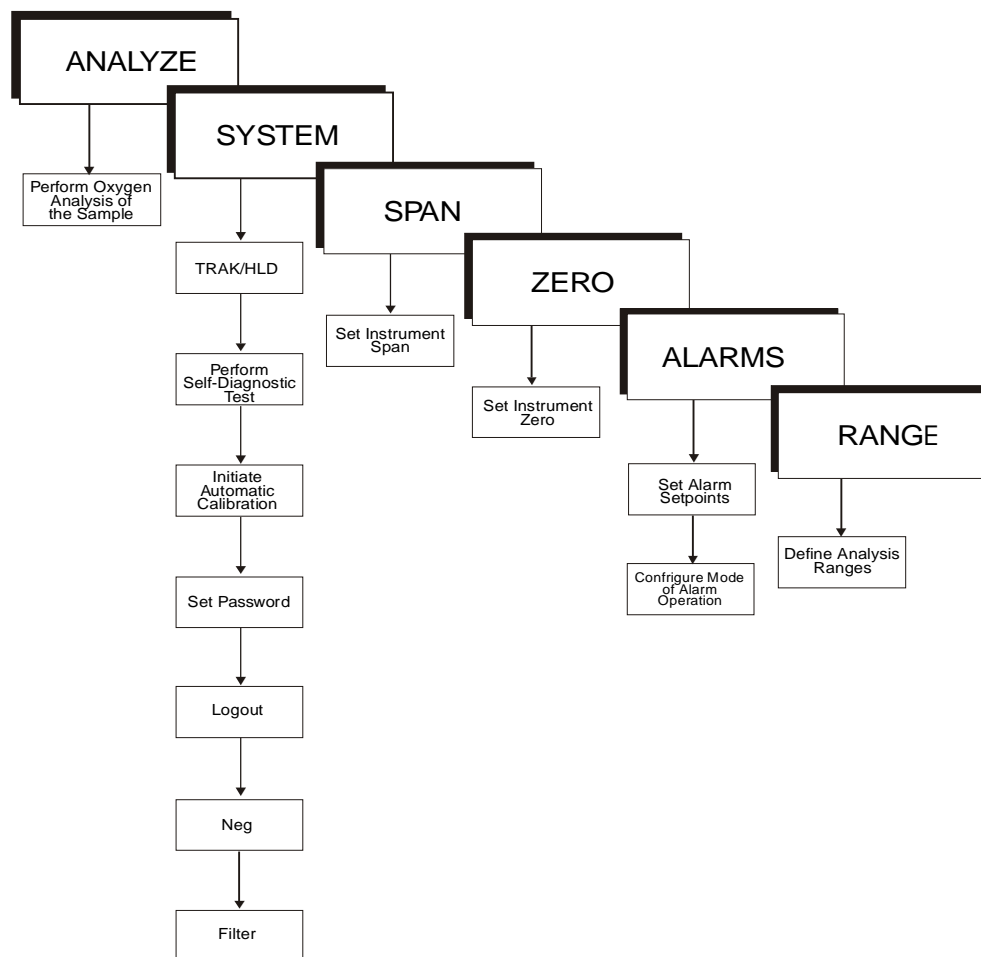


Figure 4-1: Hierarchy of Functions and Subfunctions

### 4.3 The System Function

The subfunctions of the *System* function are described below. Specific procedures for their use follow the descriptions:

- **Auto-Cal:** Used to define an automatic calibration sequence and/or start an Auto-Cal.
- **PSWD:** Security can be established by choosing a 5 digit password (PSWD) from the standard ASCII character set. (See *Installing or Changing the Password*, below, for a table of ASCII characters available.) Once a unique password is assigned and activated, the operator **MUST** enter the **UNIQUE** password to gain access to set-up functions which alter the instrument's operation, such as setting the instrument span or zero setting, adjusting the alarm setpoints, or defining analysis ranges.

After a password is assigned, the operator must **log out** to activate it. Until then, anyone can continue to operate the instrument without entering the new password.

**Only one password can be defined.** Before a unique password is assigned, the system assigns **TETAI** by default. This allows access to anyone. After a unique password is assigned, to defeat the security, the password must be changed back to **TETAI**.

- **Logout:** Logging out prevents unauthorized tampering with analyzer settings.
- **More:** Select and enter **More** to get a new screen with additional subfunctions listed.
- **Self-Test:** The instrument performs a self-diagnostic test to check the integrity of the power supply, output boards and amplifiers.
- **Version:** Displays Manufacturer, Model, and Software Version of instrument.
- **Neg:** The operator selects whether display can show negative oxygen readings or not.
- **TRAK/HLD:** The operator sets whether the instrument analog outputs track the concentration change during calibration and sets a time delay for the concentration alarms after calibration.
- **Filter:** This is to set the response time of the digital filter in the LO range.

#### 4.3.1 Tracking the Oxygen Readings during Calibration and Alarm delay

The user has the option of setting the preference as to whether the analog outputs track the display readings during calibration or not. To set the preference, press the System key once and the first System menu will appear in the VFD display:

```
TRAK/HLD Auto-Cal
PSWD Logout More
```

TRAK/HLD should be blinking. To enter this system menu press the Enter key once:

```
Output Sttng: TRACK
Alarm Dly: 10 min
```

Or

```
Output Sttng: HOLD
Alarm Dly: 10 min
```

In the first line, TRACK or HOLD should be blinking. The operator can toggle between TRACK and HOLD with the Up or Down keys. When TRACK is selected, the analog outputs (0-1 VDC and 4-20 ma) and the range ID contacts will track the instrument readings during calibration (either zero or span). TRACK is the factory default.

When HOLD is selected, the analog outputs (0-1 VDC and 4-20 ma) and the range ID contacts will freeze on their last state before entering one of the calibration modes. When the instrument returns to the Analyze mode, either by a successful or an aborted calibration, there will be a three-minute delay before the analog outputs and the range ID contacts start tracking again.

The concentration alarms freeze on their last state before entering calibration regardless of selecting HOLD or TRACK. But, when HOLD is selected the concentration alarms will remain frozen for the time displayed in the second line of the TRAK/HLD menu after the analyzer returns to the Analyze mode.

The factory default is three minutes, but the delay time is programmable. To adjust to delay time use the Left or Right arrow keys. When the time displayed on the second line blinks, it can be adjusted by Pressing the Up or Down keys to increase or decrease its value. The minimum delay is 1 minute, the maximum is 30.

This preference is stored in non-volatile memory so that it is recovered if power is removed from the instrument.

### 4.3.2 Setting up an Auto-Cal

When proper automatic valving is connected (see chapter 3, *installation*), the Analyzer can cycle itself through a sequence of steps that automatically calibrates the instrument.

**Note:** If you require highly accurate Auto-Cal timing, use external Auto-Cal control where possible. The internal clock in the Model 3000-XL is accurate to 2-3 %. Accordingly, internally scheduled calibrations can vary 2-3 % per day.

To setup an Auto-Cal cycle:

**CAUTION:**

*We do not recommend frequent Zero adjustments of the cell. A newly installed cell may take 7-10 days of operation to reach a steady Zero (typically less than 0.2 ppm). If required, the instrument may be zeroed*

*after this initial stabilizing period and may be checked again after a additional 7-10 day frequency of zero adjustment is at the discretion of the user (once a month is suggested).*

Choose **System** from the Function buttons. The LCD will display five subfunctions.

```
TRAK/HLD Auto-Cal
PSWD Logout More
```

Use < > arrows to blink Auto-Cal, and press **Enter**. A new screen for **Span/Zero** set appears.

```
Span OFF  Nxt:  0d 0h
Zero OFF  Nxt:  0d 0h
```

Press < > arrows to blink Span (or Zero), then press **Enter** again. (You won't be able to set **OFF** to **ON** if a zero interval is entered.) A **Span Every ...** (or **Zero Every ...**) screen appears.

```
Span Every 0  d
Start 0 h from now
```

Use  $\Delta \nabla$  arrows to set an interval value, then use < > arrows to move to the start-time value. Use  $\Delta \nabla$  arrows to set a start-time value.

To turn **ON** the **Span** and/or **Zero** cycles (to activate **Auto-Cal**): Press **System** again, choose **Auto-Cal**, and press **Enter** again. When the **Span/Zero** values screen appears, use the < > arrows to blink the **Span** (or **Zero**) **OFF/ON** field. Use  $\Delta \nabla$  arrows to set the **OFF/ON** field to **ON**. You can now turn these fields **ON** because there is a nonzero span interval defined.

### 4.3.3 Password Protection

If a password is assigned, then setting the following system parameters can be done only after the password is entered: **span** and **zero** settings, **alarm** setpoints, analysis **range** definitions, switching between **autoranging** and manual override, setting up an **auto-cal**, and assigning a new **password**. However, the instrument can still be used for analysis or for initiating a self-test without entering the password.

If you have decided not to employ password security, use the default password **TETAI**. This password will be displayed automatically by the microprocessor. The operator just presses the Enter key to be allowed total access to the instrument's features.

**NOTE:** If you use password security, it is advisable to keep a copy of the password in a separate, safe location.



### 4.3.3.1 Entering the Password

To install a new password or change a previously installed password, you must key in and *ENTER* the old password first. If the default password is in effect, pressing the *ENTER* button will enter the default **TETAI** password for you.

Press *System* to enter the *System* mode.

```
TRAK/HLD Auto-Cal
PSWD Logout More
```

Use the < > arrow keys to scroll the blinking over to **PSWD**, and press *Enter* to select the password function. Either the default **TETAI** password or **AAAAA** place holders for an existing password will appear on screen depending on whether or not a password has been previously installed.

```
T E T A I
Enter PWD

OR

A A A A A
Enter PWD
```

The screen prompts you to enter the current password. If you are not using password protection, press *Enter* to accept **TETAI** as the default password. If a password has been previously installed, enter the password using the < > arrow keys to scroll back and forth between letters, and the  $\Delta \nabla$  arrow keys to change the letters to the proper password. Press *Enter* to enter the password.

If the password is accepted, the screen will indicate that the password restrictions have been removed and you have clearance to proceed.

```
PSWD Restrictions
Removed
```

In a few seconds, you will be given the opportunity to change this password or keep it and go on.

```
Change Password?
<ENT>=Yes    <ESC>=No
```

Press *Escape* to move on, or proceed as in *Changing the Password*, below.

### 4.3.3.2 Installing or Changing the Password

If you want to install a password, or change an existing password, proceed as above in *Entering the Password*. When you are given the opportunity to change the password:

```
Change Password?
<ENT>=Yes    <ESC>=No
```

Press *Enter* to change the password (either the default **TETAI** or the previously assigned password), or press *Escape* to keep the existing password and move on.

If you chose *Enter* to change the password, the password assignment screen appears.

```
T E T A I
<ENT> To Proceed

or

A A A A A
<ENT> To Proceed
```

Enter the password using the < > arrow keys to move back and forth between the existing password letters, and the  $\Delta \nabla$  arrow keys to change the letters to the new password. The full set of 94 characters available for password use are shown in the table below.

#### Characters Available for Password Definition:

A	B	C	D	E	F	G	H	I	J
K	L	M	N	O	P	Q	R	S	T
U	V	W	X	Y	Z	[	¥	]	^
_	`	a	b	c	d	e	f	g	h
i	j	k	l	m	n	o	p	q	r
s	t	u	v	w	x	y	z	{	
}	→	!	"	#	\$	%	&	'	(
)	*	+	'	-	.	/	0	1	2
3	4	5	6	7	8	9	:	;	<
=	>	?	@						

When you have finished typing the new password, press *Enter*. A verification screen appears. The screen will prompt you to retype your password for verification.

```
A A A A A
Retype PWD To Verify
```

Wait a moment for the entry screen. You will be given clearance to proceed.

```

A A A A A
<ENT> TO Proceed

```

Use the arrow keys to retype your password and press *Enter* when finished. Your password will be stored in the microprocessor and the system will immediately switch to the *Analyze* screen, and you now have access to all instrument functions.

If all alarms are defeated, the *Analyze* screen appears as:

```

0.0          ppm   Anlz
Range:   0 - 100

```

If an alarm is tripped, the second line will change to show which alarm it is:

```

0.0          ppm   Anlz
AL-1

```

**NOTE: If you log off the system using the logout function in the system menu, you will now be required to re-enter the password to gain access to Span, Zero, Alarm, and Range functions.**

#### 4.3.4 Logout

The **Logout** function provides a convenient means of leaving the analyzer in a password protected mode without having to shut the instrument off. By entering **Logout**, you effectively log off the instrument leaving the system protected against use until the password is reentered. To log out, press the *System* button to enter the *System* function.

```

TRAK/HLD Auto-Cal
PSWD Logout More

```

Use the <> arrow keys to position the blinking over the **Logout** function, and press *Enter* to Log out. The screen will display the message:

```

Protected Until
Password Reentered

```

#### 4.3.5 System Self-Diagnostic Test

The Model 3000 has a built-in self-diagnostic testing routine. Pre-programmed signals are sent through the power supply, output board and sensor circuit. The return signal is analyzed, and at the end of the test the

status of each function is displayed on the screen, either as **OK** or as a number between 1 and 3. (See *System Self Diagnostic Test* in chapter 5 for number code.)

The self diagnostics are run automatically by the analyzer whenever the instrument is turned on, but the test can also be run by the operator at will. To initiate a self diagnostic test during operation:

Press the **System** button to start the **System** function.

```
TRAK/HLD Auto-Cal  
PSWD Logout More
```

Use the < > arrow keys to blink **More**, then press **Enter**.

```
Version Self-Test  
Neg-N Filter-5
```

Use the < > arrow keys again to move the blinking to the **Self-Test** function. The screen will follow the running of the diagnostic.

```
RUNNING DIAGNOSTIC  
Testing Preamp - 83
```

During preamp testing there is a countdown in the lower right corner of the screen. When the testing is complete, the results are displayed.

```
Power: OK Analog: OK  
Preamp: 3
```

The module is functioning properly if it is followed by **OK**. A number indicates a problem in a specific area of the instrument. Refer to Chapter 5 *Maintenance and Troubleshooting* for number-code information. The results screen alternates for a time with:

```
Press Any Key  
To Continue...
```

Then the analyzer returns to the initial System screen.

#### 4.3.6 Version Screen

Move the < > arrow key to **More** and press **Enter**. With **Version** blinking, press **Enter**. The screen displays the manufacturer, model, and software version information.

### 4.3.7 Filter Function

The response time on the most sensitive range (ppb range) is user definable from approximately 1-60 minutes. The adjustable filter allows the user to tune the response of the analyzer to best balance sensor noise and response time requirements. The factory default setting is 5 minutes. The actual response time will depend on the user's sample system (the length and size the tubing of tubing as well as the sample flow rate).

The filter setting can be accessed by selecting **SYSTEM** on the keypad followed by **MORE** on the display with the <> keys. The filter function is then selected and changed using the arrow keys. Press **ENTER** and **ANALYZE** to return to analyze mode.

In the event of an over-range condition, the filter rate will automatically switch to a faster setting (approximately 45 sec. response time) for the duration of the over-range or upset condition. This feature allows the analyzer to quickly respond to and track an upset condition.

## 4.4 Calibration of the Analyzer

The analyzer must be calibrated prior to its use. For most applications where the desired range of measurement is 0 to 10 ppm, or less we recommend the analyzer be calibrated using a span gas as detailed below:

### Span Gas Calibration

Before the cell is ready for calibration, it must be purged with sample gas to a low oxygen level preferably below 0.1 ppm. However, if the oxygen contact of the sample gas is higher than 0.1 ppm, a zero gas such as nitrogen with oxygen level below 0.1 ppm may be required.

The recommended span gas concentration is between 7.0 to 9.0 ppm oxygen in nitrogen, and will require calibration be performed in the 0-10 ppm analyzer range.

#### 4.4.1 Zero Cal

The B-2CXL cell has a zero offset of less than 0.1 ppm oxygen. Normally, the offset slowly decreases during the first 7 to 10 days of operation, and is expected to reach a steady value after this time.

Generally, the value of the zero offset is part of the oxygen reading of the sample gas as shown by the analyzer readout. As an example, a reading of 0.5 ppm oxygen may include 0.4 ppm oxygen in the sample gas and a 0.1 ppm zero offset.

The determination of the zero offset requires the use of oxygen free gas to the analyzer. We recommend the use of nitrogen gas with a scrubber to assure oxygen levels below 20 ppb.

The user may decide to eliminate the zero offset for improved accuracy. If so desired the analyzer is equipped to provide this function. However, we do not recommend carrying out the cal zero during the first 10 days of the operation of the cell.

The *Zero* button on the front panel is used to enter the zero calibration function. Zero calibration can be performed in either the automatic or manual mode. In the **automatic** mode, an internal algorithm compares consecutive readings from the sensor to determine when the output is within the acceptable range for zero. In the **manual** mode, the operator determines when the reading is within the acceptable range for zero. Make sure the zero gas is connected to the instrument. If you get a **CELL FAILURE** message skip to section 4.4.1.3.

#### 4.4.1.1 Auto Mode Zeroing

Press *Zero* to enter the zero function mode. The screen allows you to select whether the zero calibration is to be performed automatically or manually. Use the  $\Delta\nabla$  arrow keys to toggle between **AUTO** and **MAN** zero settling. Stop when **AUTO** appears, blinking, on the display.

```
Zero: Settling: AUTO
<ENT> To Begin
```

Press *Enter* to begin zeroing.

```
####      PPM      Zero
Slope=####      ppm/s
```

The beginning zero level is shown in the upper left corner of the display. As the zero reading settles, the screen displays and updates information on **Slope** (unless the Slope starts within the acceptable zero range and does not need to settle further).

Then, and whenever Slope is less than 0.08 for at least 3 minutes, instead of Slope you will see a countdown: **5 Left**, **4 Left**, and so fourth. These are five steps in the zeroing process that the system must complete, **AFTER** settling, before it can go back to *Analyze*.

```
####      PPM   Zero
4 Left=###      ppm/s
```

The zeroing process will automatically conclude when the output is within the acceptable range for a good zero. Then the analyzer automatically returns to the *Analyze* mode.

Because the reading of the slope is not very sensitive, it is recommended that zero gas be purging a few minutes before starting the Auto mode zeroing. This will ensure cell stability on the new Zero settings.

#### 4.4.1.2 Manual Mode Zeroing

Press *Zero* to enter the *Zero* function. The screen that appears allows you to select between automatic or manual zero calibration. Use the  $\Delta\nabla$  keys to toggle between **AUTO** and **MAN** zero settling. Stop when **MAN** appears, blinking, on the display.

```
Zero: Settling: Man
<ENT> To Begin
```

Press *Enter* to begin the zero calibration. After a few seconds the first of five zeroing screens appears. The number in the upper left hand corner is the first-stage zero offset. The microprocessor samples the output at a predetermined rate. It calculates the differences between successive samplings and displays the rate of change as **Slope**= a value in parts per million per second (ppm/s).

```
####      ppm   Zero
Slope=####      ppm/s
```

**NOTE: It takes several seconds for the true Slope value to display. Wait about 10 seconds. Then, wait until Slope is sufficiently close to zero before pressing *Enter* to finish zeroing .**

Generally, you have a good zero when **Slope** is less than 0.05 ppm/s for about 30 seconds. When **Slope** is close enough to zero, press *Enter*. In a few seconds, the screen will update.

Once zero settling is completed, the information is stored in the microprocessor, and the instrument automatically returns to the *Analyze* mode.

#### 4.4.1.3 Cell Failure

Cell failure in the Ultra Trace 3000 is usually associated with inability to zero the instrument down to a satisfactorily low ppm reading corresponding to a current of 2 nanoamps (approx. 1 ppm). When this occurs, the

instrument returns back to analyzer mode without taking the zero calibration. The Ultra Trace 3000 system alarm trips, and the LCD displays a failure message.

```

.#          ppm  Anlz
CELL FAIL/ ZERO HIGH

```

Before replacing the cell:

- a. Check your span gas to make sure it is within specifications.
- b. Check for leaks up-stream from the cell, where oxygen may be leaking into the system.
- c. Check if more purging time with Zero calibration gas is needed.

If there are no leaks and the span gas is within specification, replace the cell as described in chapter 5, *Maintenance*.

The failure alarm and failure message will reset after entering the Zero mode.

#### 4.4.2 Span Cal

The *Span* button on the front panel is used to span calibrate the analyzer. Span calibration can be performed using the **automatic** mode, where an internal algorithm compares consecutive readings from the sensor to determine when the output matches the span gas concentration. Span calibration can also be performed in **manual** mode, where the operator determines when the span concentration reading is acceptable and manually exits the function.

##### 4.4.2.1 Auto Mode Spanning

Press *Span* to enter the span function. The screen that appears allows you to select whether the span calibration is to be performed automatically or manually. Use the  $\Delta\nabla$  arrow keys to toggle between **AUTO** and **MAN** span settling. Stop when **AUTO** appears, blinking, on the display.

```

Span: Settling: AUTO
<ENT> For Next

```

Press *Enter* to move to the next screen.

```

Calib. Holding time
Cal hold: 5 min

```



This menu allows the operator to set the time the analyzer should be held in the AUTO span mode, after the readings of the analyzer settle. Five minutes is the default, but it could be adjusted anywhere from 1 to 60 minutes by using the UP or DOWN keys.

Press *Enter* to move to the next screen.

```
Span Val:  008.00 ppm
<ENT>Span <UP>Mod #
```

Use the  $\Delta\nabla$  arrow keys to enter the oxygen-concentration mode (999.99 ppm is maximum value of span gas allowed). Use the <> arrow keys to blink the digit you are going to modify. Use the  $\Delta\nabla$  arrow keys again to change the value of the selected digit. When you have finished typing in the concentration of the span gas you are using, press *Enter* to begin the Span calibration.

```
####      ppm      Span
Slope=####      ppm/s
```

The beginning span value is shown in the upper left corner of the display. As the span reading settles, the screen displays and updates information on **Slope**. Spanning automatically ends when the span output corresponds, within tolerance, to the value of the span gas concentration. Then the instrument automatically returns to the analyze mode.

#### 4.4.2.2 Manual Mode Spanning

Press *Span* to start the *Span* function. The screen that appears allows you to select whether the span calibration is to be performed automatically or manually.

```
Span: Settling:MAN
<ENT> For Next
```

Use the  $\Delta\nabla$  keys to toggle between **AUTO** and **MAN** span settling. Stop when **MAN** appears, blinking, on the display. Press *Enter* to move to the next screen.

Press *Enter* to move to the next screen.

```
Calib. Holding time
Cal hold:  5  min
```

This menu allows the operator to set the time the analyzer should be held in the AUTO span mode. It does not have any effect in the MANual mode. Just press *Enter* key to continue.

```
Span Val: 008.00ppm
<ENT>Span <UP>Mod #
```

Press  $\Delta$  (<UP>) to permit modification (**Mod #**) of span value.

Use the arrow keys to enter the oxygen concentration of the span gas you are using (999.99 is maximum value of span gas). The <> arrows choose the digit, and the  $\Delta$   $\nabla$  arrows choose the value of the digit.

Press *Enter* to enter the span value into the system and begin the span calibration.

Once the span has begun, the microprocessor samples the output at a predetermined rate. It calculates the difference between successive samplings and displays this difference as a Slope on the screen. It takes several seconds for the first Slope value to display. Slope indicates the rate of change of the Span reading. It is a sensitive indicator of stability.

```
####          % Span
Slope=####    ppm/s
```

When the Span value displayed on the screen is sufficiently stable, press *Enter*. (Generally, when the Span reading changes by 1 % or less of the full scale of the range being calibrated, for a period of ten minutes it is sufficiently stable.) Once *Enter* is pressed, the Span reading changes to the correct value. The instrument then **automatically** enters the *Analyze* function.

### 4.4.3 Span Failure

The analyzer checks the output of the cell at the end of the span. If the raw output of the cell is less than 0.5  $\mu\text{A/ppm O}_2$ , the span will not be accepted. The analyzer will return to the previous calibration values, trigger the System Alarm, and display in the VFD:

```
Span Failed!!
```

This message will be shown for five seconds and the instrument shall return to the Analyze mode. In the upper right hand corner of the VFD display "FCAL" will be shown. This message flag will help the operator troubleshoot in case calibration was initiated remotely. To reset the alarm and the flag message, the analyzer must be properly spanned.

A trace cell is unlikely to fail span. As explained before, when the sensor reaches the end of its useful life, the zero offset begins to rise until the analyzer finds the zero unsatisfactory. Nevertheless, feeding the wrong span

gas or electronics failure could set this feature off at the end of the span. Consider this before replacing the cell.

## 4.5 Switching of Sample Streams

The Model Ultra Trace 3000 may be used to monitor more than one type of sample gas, such as nitrogen and helium, or two streams of nitrogen containing low (less than 1 ppm) and high (500 to 1000 ppm) concentrations of oxygen.

For these applications, we recommend the following parameters and conditions be followed:

1. While switching streams, such as between nitrogen and helium, both the gas streams must be made to flow continuously even through only one stream is going through the analyzer at one time. Failure to do so may result in spikes in output when the dead-ended stream is switched in. For more discussion of this, read the Technical Bulletin - TB00001, dated 3-98. This Bulletin is available upon request from TATAI.
2. The analyzer is capable of handling the switching of streams without effecting the sensitivity of the cell. This switching of streams between nitrogen and helium will not require SPAN adjustment. However, care must be taken to keep sample flow rates in the desired levels, as the flowmeter is calibrated for air and nitrogen streams only.
3. The analyzer can withstand repeated switching of streams between low oxygen levels of less than 1 ppm and high oxygen levels of 5000 to 1000 ppm. Again, care must be taken to ensure proper and continuous flows at all times.

### 4.5.1 Special Notes on Hydrogen Gas Stream

The standard oxygen cell, Model B-2CXL, though tested in nitrogen gas streams is expected to perform well in hydrogen streams. However, for certain applications such as continuous monitoring of very low levels of oxygen in hydrogen, the user may request cells that have been specifically tested in hydrogen streams. Consult Teledyne for further details.

## 4.6 The Alarms Function

The Model Ultra Trace 3000 is equipped with 2 fully adjustable concentration alarms and a system failure alarm. Each alarm has a relay with a

---

set of form “C” contacts rated for 3 amperes resistive load at 250 V ac. See Figure 3-5 in Chapter 3, *Installation* and/or the Interconnection Diagram included at the back of this manual for relay terminal connections.

The system failure alarm has a fixed configuration as described in chapter 3 *Installation*.

The concentration alarms can be configured from the front panel as either *high* or *low* alarms by the operator. The alarm modes can be set as *latching* or *non-latching*, and either *failsafe* or *non-failsafe*, or, they can be *defeated* altogether. The setpoints for the alarms are also established using this function.

Decide how your alarms should be configured. The choice will depend upon your process. Consider the following four points:

1. Which if any of the alarms are to be high alarms and which if any are to be low alarms?

Setting an alarm as HIGH triggers the alarm when the oxygen concentration rises above the setpoint. Setting an alarm as LOW triggers the alarm when the oxygen concentration falls below the setpoint.

Decide whether you want the alarms to be set as:

- Both high (high and high-high) alarms, or
- One high and one low alarm, or
- Both low (low and low-low) alarms.

2. Are either or both of the alarms to be configured as failsafe?

In failsafe mode, the alarm relay de-energizes in an alarm condition. For non-failsafe operation, the relay is energized in an alarm condition. You can set either or both of the concentration alarms to operate in failsafe or non-failsafe mode.

3. Are either of the alarms to be latching?

In latching mode, once the alarm or alarms trigger, they will remain in the alarm mode even if process conditions revert back to non-alarm conditions. This mode requires an alarm to be recognized before it can be reset. In the non-latching mode, the alarm status will terminate when process conditions revert to non-alarm conditions.

4. Are either of the alarms to be defeated?

The defeat alarm mode is incorporated into the alarm circuit so that maintenance can be performed under conditions which would normally activate the alarms.

The defeat function can also be used to reset a latched alarm.  
(See procedures, below.)

If you are using password protection, you will need to enter your password to access the alarm functions. Follow the instructions in section 4.3.3 to enter your password. Once you have clearance to proceed, enter the *Alarm* function.

Press the *Alarm* button on the front panel to enter the *Alarm* function. Make sure that AL-1 is blinking.

```
AL-1      AL-2
Choose Alarm
```

Set up alarm 1 by moving the blinking over to AL-1 using the < > arrow keys. Then press *Enter* to move to the next screen.

```
AL-1 10.000 ppm HI
Dft-N Fs-N Ltch-N
```

Five parameters can be changed on this screen:

- Value of the alarm setpoint, AL-1 ##### ppm (oxygen); value can be set from 0 to 999 ppb + 1.000-1000.00 ppm.
- Out-of-range direction, HI or LO
- Defeated? Dft-Y/N (Yes/No)
- Failsafe? Fs-Y/N (Yes/No)
- Latching? Ltch-Y/N (Yes/No).
- To define the setpoint, use the < > arrow keys to move the blinking over to AL-1 #####. Then use the  $\Delta$   $\nabla$  arrow keys to change the number. Holding down the key speeds up the incrementing or decrementing. (Remember, the setpoint units are ppm O<sub>2</sub>.)
- To set the other parameters use the < > arrow keys to move the blinking over to the desired parameter. Then use the  $\Delta$   $\nabla$  arrow keys to change the parameter.
- Once the parameters for alarm 1 have been set, press *Alarms* again, and repeat this procedure for alarm 2 (AL-2).
- To reset a latched alarm, go to **Dft-** and then press either  $\Delta$  two times or  $\nabla$  two times. (Toggle it to **Y** and then back to **N**.)

–OR–

Go to **Ltch-** and then press either  $\Delta$  two times or  $\nabla$  two times. (Toggle it to **N** and back to **Y**.)

Alarm Hysterisis: There is alarm hysterisis to prevent chatter of the alarm contacts. It is set to 0.2 ppm for alarms set above 1 ppm, and 10 ppb for alarms set below 1 ppm.

## 4.7 The *Range* Function

The Range function allows the operator to program up to three concentration ranges to correlate with the DC analog outputs. If no ranges are defined by the user, the instrument defaults to:

Low = 0–250 ppb  
Med = 0–1 ppm  
High = 0–10 ppm.

The Model Ultra Trace 3000 is set at the factory to default to autoranging. In this mode, the microprocessor automatically responds to concentration changes by switching ranges for optimum readout sensitivity. If the current range limits are exceeded, the instrument will automatically shift to the next higher range. If the concentration falls to below 90% of full scale of the next lower range, the instrument will switch to that range. A corresponding shift in the DC percent-of-range output, and in the range ID outputs, will be noticed.

The autoranging feature can be overridden so that analog output stays on a fixed range regardless of the oxygen concentration detected. If the concentration exceeds the upper limit of the range, the DC output will saturate at 1 V dc (20 mA at the current output).

However, the digital readout and the RS-232 output of the concentration are unaffected by the fixed range. They continue to read accurately with full precision. See *Front Panel* description in Chapter 1.

The automatic fourth range is always 0-1000 ppm and is not programmable.

### 4.7.1 Setting the Analog Output Ranges

To set the ranges, enter the range function mode by pressing the *Range* button on the front panel.

L–250 ppb      M–1 ppm  
H–10 ppm      Mode–AUTO

Use the < > arrow keys to blink the range to be set: low (L), medium (M), or high (H).

Use the  $\Delta\nabla$  arrow keys to enter the upper value of the range (all ranges begin at 0). Repeat for each range you want to set. Press *Enter* to accept the values and return to *Analyze* mode. (See note below.)

**Note:** The ranges must be increasing from low to high, for example, if range 1 is set as 0–500 ppb and range 2 is set as 0–10 ppm, range 3 cannot be set as 0–5 ppm since it is lower than range 2.

Ranges, and alarms, are set in ppb or ppm units depending on concentration. All concentration-data outputs change from ppb units to ppm when the concentration is above 1.0 ppm. Range Low (L) is always a ppb range and cannot be set higher than 1000 ppb nor lower than 10 ppb. Ranges medium (M) and High (H) can only be set in ppm. The Medium (M) range can be set between 1 and 10 ppm, while the high (H) range can be set between 10 and 1000 ppm.

#### 4.7.2 Fixed Range Analysis

The autoranging mode of the instrument can be overridden, forcing the analyzer DC outputs to stay in a single predetermined range.

To switch from autoranging to fixed range analysis, enter the range function by pressing the *Range* button on the front panel.

Use the < > arrow keys to move the blinking over **AUTO**.

Use the  $\Delta\nabla$  arrow keys to switch from **AUTO** to **FX/L**, **FX/M**, or **FX/H** to set the instrument on the desired fixed range (low, medium, or high).

L–250ppb          M–1 ppm  
H–10 ppm        Mode–FX/L

or

L–250 ppb          M–1 ppm  
H–10 ppm        Mode–FX/M

or

L–250 ppb          M–1 ppm  
H–10 ppm        Mode–FX/H

Press *Escape* to re-enter the *Analyze* mode using the fixed range.



**NOTE:** When performing analysis on a fixed range, if the oxygen concentration rises above the upper limit (or default value) as established by the operator for that particular range, the output saturates at 1 V dc (or 20 mA). However, the digital readout and the RS-232 output continue to read the true value of the oxygen concentration regardless of the analog output range.

## 4.8 The *Analyze* Function

Normally, all of the functions automatically switch back to the *Analyze* function when they have completed their assigned operations. Pressing the *Escape* button in many cases also switches the analyzer back to the *Analyze* function. Alternatively, you can press the *Analyze* button at any time to return to analyzing your sample.

## 4.9 Signal Output

The standard Model Ultra Trace 3000 Oxygen Analyzer is equipped with two 0–1 V dc analog output terminals accessible on the back panel

(one concentration and one range ID), and two isolated 4–20 mA dc current outputs (one concentration and one range ID).

See *Rear Panel* in Chapter 3, *Installation*, for illustration.

The signal output for concentration is linear over the currently selected analysis range. For example, if the analyzer is set on range that was defined as 0–100 ppm O<sub>2</sub>, then the output would be:

ppm O <sub>2</sub>	Voltage Signal Output (V dc)	Current Signal Output (mA dc)
0	0.0	4.0
10	0.1	5.6
20	0.2	7.2
30	0.3	8.8
40	0.4	10.4
50	0.5	12.0
60	0.6	13.6
70	0.7	15.2
80	0.8	16.8
90	0.9	18.4
100	1.0	20.0

The analog output signal has a voltage which depends on the oxygen concentration AND the currently activated analysis range. To relate the signal output to the actual concentration, it is necessary to know what range the instrument is currently on, especially when the analyzer is in the autoranging mode.



To provide an indication of the range, a second pair of analog output terminals are used. They generate a steady preset voltage (or current when using the current outputs) to represent a particular range. The following table gives the range ID output for each analysis range:

<b>Range</b>	<b>Voltage (V)</b>	<b>Current (mA)</b>
LO	0.25	8
MED	0.50	12
HI	0.75	16
(0-1000ppm)	1.00	20



## Maintenance

---

### 5.1 Routine Maintenance

Aside from normal cleaning and checking for leaks at the gas connections, routine maintenance is limited to replacing Micro-Fuel cells and fuses, and recalibration. For recalibration, see Section 4.4 *Calibration*.

**WARNING:** SEE WARNINGS ON THE TITLE PAGE OF THIS MANUAL.

### 5.2 Cell Replacement

The B-2CXL Micro-Fuel Cell is a sealed electrochemical transducer with no electrolyte to change or electrodes to clean. When the cell reaches the end of its useful life, it is replaced. The spent fuel cell should be discarded according to local regulations. This section describes fuel cell care as well as when and how to replace it.

#### 5.2.1 Storing and Handling Replacement Cells

To have a replacement cell available when it is needed, TAI recommends that one spare cell be purchased 9-10 months after commissioning the Ultra Trace 3000, or shortly before the end of the cell's one year warranty period.



**CAUTION:** *Do not stockpile cells. The warranty period starts on the day of shipment.*

The spare cell should be carefully stored in an area that is not subject to large variations in ambient temperature (75 °F nominal) or to rough handling.

**WARNING:** THE SENSOR USED IN THE MODEL 3000 TRACE OXYGEN ANALYZER USES ELECTROLYTES WHICH CONTAIN TOXIC SUBSTANCES, MAINLY LEAD AND POTASSIUM HYDROXIDE, THAT CAN BE HARMFUL IF TOUCHED, SWALLOWED, OR INHALED. AVOID CONTACT WITH ANY FLUID OR POWDER IN OR AROUND THE UNIT. WHAT MAY APPEAR TO BE PLAIN WATER COULD CONTAIN ONE OF THESE TOXIC SUBSTANCES. IN CASE OF EYE CONTACT, IMMEDIATELY FLUSH EYES WITH WATER FOR AT LEAST 15 MINUTES. CALL PHYSICIAN. (SEE APPENDIX, MATERIAL SAFETY DATA SHEET.)



**CAUTION:** *Do not disturb the integrity of the cell package until the cell is to actually be used. If the cell package is punctured and air is permitted to enter, the cell will require an excessively long time to reach zero after installation (1-2 weeks!).*



### 5.2.2 When to Replace a Cell

Cell failure in the Ultra Trace 3000 is usually characterized by a significant increase in the zero offset of more than 1.0 ppm (2 nanoamps sensor output approximately) oxygen or the inability to calibrate the sensor. When this occurs, the Ultra Trace 3000 will still Zero but the system alarm trips, and the LCD displays a failure message.

#.# ppm Anlz  
CELL FAIL/ ZERO HIGH

Before replacing the cell:

- Check your span and zero gas to make sure it is within specifications.
- Check for leaks up-stream from the cell, where oxygen may be leaking into the system.
- Check if more purging time with zero calibration gas is needed.

If there are no leaks and the span gas is within specification, replace the cell.

The failure alarm and the failure message will reset after re-entering the zero mode again.

### 5.2.3 Removing the Micro-Fuel Cell

The Micro-Fuel cell is located inside the stainless steel cell block behind the front panel (see Figure 5-1). To remove an existing cell:

1. Remove power to the instrument by unplugging the power cord at the power source.
2. Open the front panel door by pressing the release button on the top right corner of the door all the way in with a narrow gauge tool.
3. With one hand hold the top of the cell block while unscrewing the plastic ring holder. Once the plastic ring is loose, remove the top of the cell block.

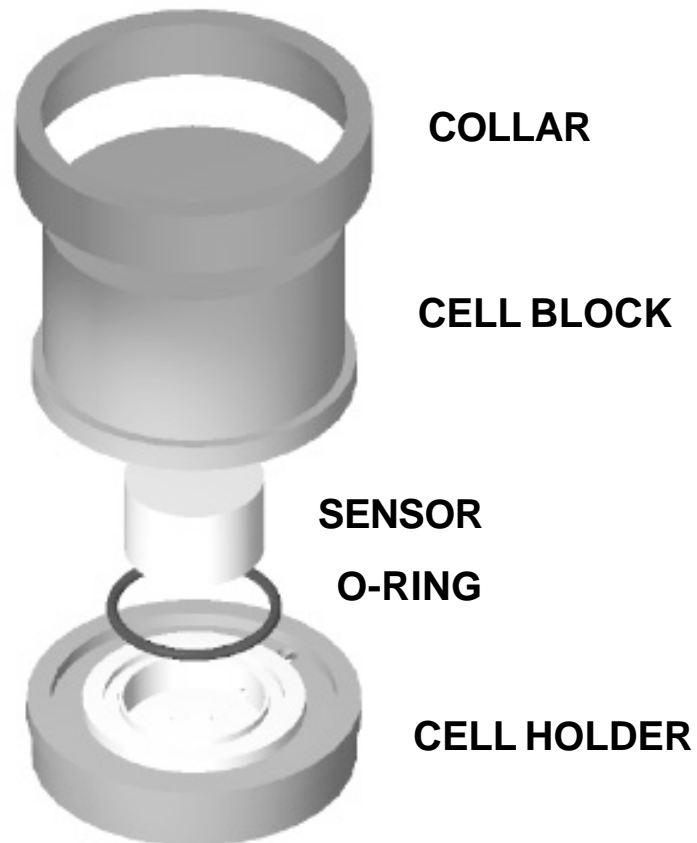


Figure 5-1: Removing the Micro-Fuel

### 5.2.4 Installing a New Micro-Fuel Cell

Before installing a new cell, check the O-ring in the base of the cell holder. Replace if worn or damaged.

1. Verify that the O-ring is properly located.
2. Place the cell on cell holder with the screen side facing down.
3. Place the cell block on top of the cell holder.
4. Hold the cell block with one hand and rotate the collar clockwise.
5. To determine if the assembly is fully seated, rotate the cell block slightly.
6. When fully seated, the cell block can be rotated with three fingers but considerable drag will be felt.

### 5.2.5 Cell Warranty

The Class B-2CXL Micro-Fuel cell is used in the Model Ultra Trace 3000. This cell is warranted for 6 months from the date of shipment. Note any Addenda attached to the front of this manual for special information applying to your instrument.

With regard to spare cells, warranty period begins on the date of shipment. The customer should purchase only one spare cell (per section 5.2.1). Do not attempt to stockpile spare cells.

**The B-2CXL cell is not designed for applications where CO<sub>2</sub> is a major component in the sample**, however concentrations of 1,000 ppm or less will not adversely effect the cell performance. Consult TAI for the appropriate cell for measuring trace oxygen in the presence of CO<sub>2</sub>.

If a cell was working satisfactorily, but ceases to function before the warranty period expires, the customer will receive credit toward the purchase of a new cell.

If you have a warranty claim, you must return the cell in question to the factory for evaluation. If it is determined that failure is due to faulty workmanship or material, the cell will be replaced at no cost to you.

**Note: Evidence of damage due to tampering or mishandling will render the cell warranty null and void.**

### 5.3 Fuse Replacement

1. Place small screwdriver in notch, and pry cover off, as shown in Figure 5-2.

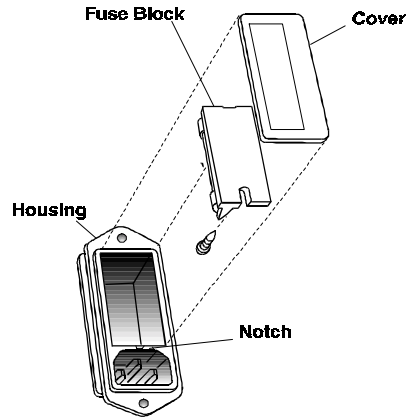


Figure 5-2: Removing Fuse Block from Housing

2. To change between American and European fuses, remove the single retaining screw, flip Fuse Block over 180 degrees, and replace screw.
3. Replace fuse as shown in Figure 5-3.
4. Reassemble Housing as shown in Figure 5-2.

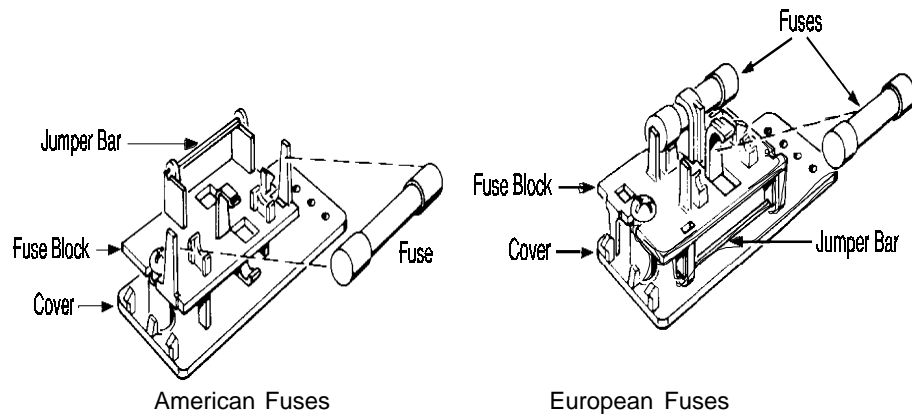


Figure 5-3: Installing Fuses

## 5.4 System Self Diagnostic Test

1. Press the *System* button to enter the system mode.
2. Use the <> arrow keys to move to *More*, and press *Enter*.
3. Use the <> arrow keys to move to *Self-Test*, and press *Enter*.

The following failure codes apply:

**Table 5-1: Self Test Failure Codes**

### Power

0	OK
1	5 V Failure
2	15 V Failure
3	Both Failed

### Analog

0	OK
1	DAC A (0–1 V Concentration)
2	DAC B (0–1 V Range ID)
3	Both Failed

### Preamp

0	OK
1	Zero too high
2	Amplifier output doesn't match test input
3	Both Failed

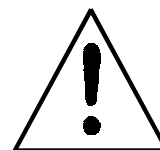
## 5.5 Major Internal Components

The Micro-Fuel cell is accessed by unlatching and swinging open the front panel, as described earlier. Other internal components are accessed by removing the rear panel and sliding out the entire chassis. See Figure 5-4, below. The gas piping is illustrated in Figure 2-4, and the major electronic components locations are shown in Figure 2-5, in chapter 2.

**WARNING: SEE WARNINGS ON THE TITLE PAGE OF THIS MANUAL.**

The Ultra Trace 3000 contains the following major components:

- Analysis Section
  - Micro Fuel Cell (B-2CXL)
  - Cell block with stainless steel wetted parts
  - Sample system





- TEC cooler assembly
- Power Supply
- Microprocessor
- Displays
  - 5 digit LED meter
  - 2 line, 20 character, alphanumeric, VFD display
- RS-232 Communications Port.
- TEC temperature controller PCB

See the drawings in the Drawings section in back of this manual for details.

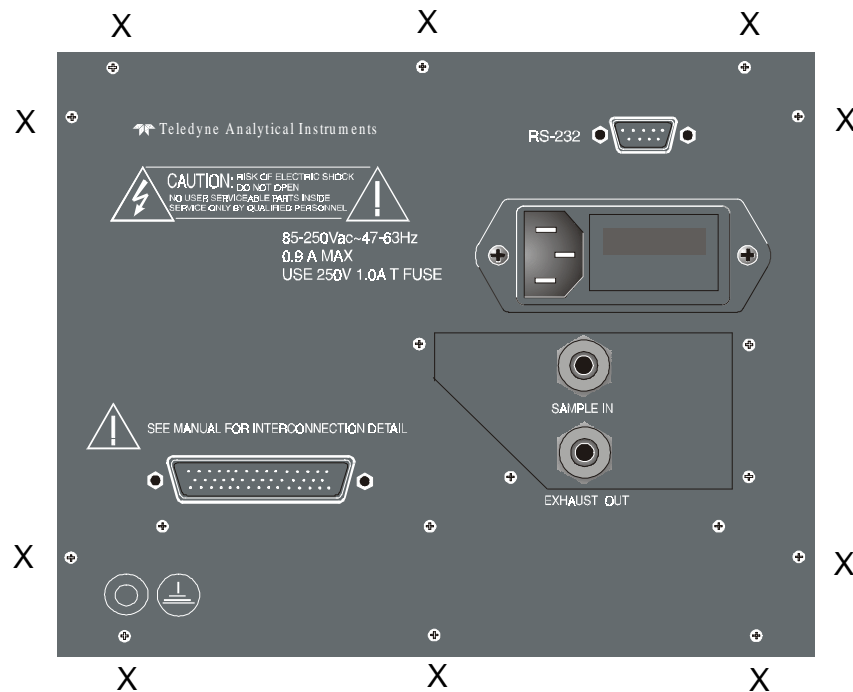


Figure 5-4: Rear-Panel Screws

To detach the rear panel, remove only the 14 screws marked with an X.

## 5.6 Cleaning

If instrument is unmounted at time of cleaning, disconnect the instrument from the power source. Close and latch the front-panel access door. Clean outside surfaces with a soft cloth dampened slightly with plain clean water. Do not use any harsh solvents such as paint thinner or benzene.

For panel-mounted instruments, clean the front panel as prescribed in the above paragraph. DO NOT wipe front panel while the instrument is controlling your process.

## 5.7 Troubleshooting

**Problem:**

Erratic readings of the Oxygen concentration as reported by the analyzer.

**Possible Cause:**

The analyzer may have been calibrated in an inaccurate fashion.

**Solution:**

Turn the analyzer off, then turn back on again. Press the System key when prompted by the analyzer "Press System for default Values". This will return the analyzer to its default settings in calibration and zero values. If erratic behavior continues clean sensor contacts or replace the sensor.

**Possible Cause:**

Atmospheric Oxygen may be diffusing in through the vent and affecting the oxygen level which the sensor sees.

**Solution:**

Increase flow rate and/or length or vent tubing in order to dilute or minimize the diffusion of oxygen from the vent back to the sensor.

**Problem:**

Inaccurate zero operation (i.e. the user has zeroed the analyzer accidentally on gas much higher than one would normally use for a zero gas).

**Solution:**

Turn the analyzer off, then back on again. Press the System key when prompted by the analyzer "Press System for default Values". This will return the analyzer to its default settings in calibration and zero values. Now proceed to carefully calibrate and zero the analyzer.

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## Appendix

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### A-1 Specifications

**Packaging: General Purpose**

- Flush panel mount (Standard).
- Relay rack mount. Contains one instrument in one 19" relay rack mountable plate (Optional).

**Sensor:** Teledyne B-2CXL trace analysis Micro-Fuel Cell.

**Cell Block:** 316 stainless steel.

**Sample System:** All wetted parts of 316 stainless steel.

**90 % Response Time:** Less than 30 seconds at 25 °C (77 °F) on 10 ppm range.  
120 seconds on 250 ppb range, programmable response in ppb range.

**Ranges:** Three user definable ranges from 0–250 ppb to 0–1,000 ppm, plus over range of 0-1,000 ppm.  
Autoranging with range ID output.

**Alarms:** One system-failure alarm contact to detect power failure or sensor-zero and span failure.  
Two adjustable concentration threshold alarm contacts with fully programmable setpoints.

**Displays:** 2-line by 20-character, VFD screen, and one 5 digit LED display.

**Digital Interface:** Full duplex RS-232 communications port.

**Power:** Universal power supply 85-250 V ac, at 47-63 Hz.

**Operating Temperature:** 5-40 °C

**Accuracy:** ±2% of full scale for all ranges except 0-250 ppb range, at constant temperature.

For 0-250 ppb range accuracy is as follows:

±5 ppb at constant temperature.

±10 ppb over temperature variation of 20° - 30°C.

±15 ppb over temperature variation of 15° - 35°C.

All accuracy specifications are contingent upon the completion of zero and span calibration.

All accuracy is established at constant pressure and equilibrium has been established.

**Analog outputs:** 0-1 V dc percent-of-range,  
0-1 V dc range ID.  
4-20 mA dc (isolated) percent-of-range,  
4-20 mA dc (isolated) range ID.

**Dimensions:** 19 cm high, 24.9 cm wide, 31 cm deep (6.96 in high, 8.7 in wide, 12.2 in deep).

## A-2 Recommended 2-Year Spare Parts List

QTY.	PART NUMBER	DESCRIPTION
1	CP2037	TEC Cooler
1	C65507	Back Panel Board
1	C62371-B	Front Panel Board
1	C71410	Preamplifier Board (Instruction)
1	C70941	TEC Controller PCB
1	C62365-A	Main Computer Board
3	F9	Fuse, 1A, 250V 3AG Slow Blow
3	F1275	Fuse, 1A, 250V 5x20mm (European) Slow Blow
1	O286	O-ring
1	C6689-B2CXL	Micro-Fuel Cell (do not store for more than 6 months)
1	CP1798	50 pin D-sub interface connector
1	F1498	Fan
50	CP1799	Pins for CP1798 connector

A minimum charge is applicable to spare parts orders.

**Note:** Orders for replacement parts should include the part number (if available) and the model and serial number of the instrument for which the parts are intended.

Orders should be sent to:

### Teledyne Analytical Instruments

16830 Chestnut Street  
City of Industry, CA 91749-1580

Phone (626) 934-1500, Fax (626) 961-2538  
TWX (910) 584-1887 TDYANYL COID

Web: [www.teledyne-ai.com](http://www.teledyne-ai.com)

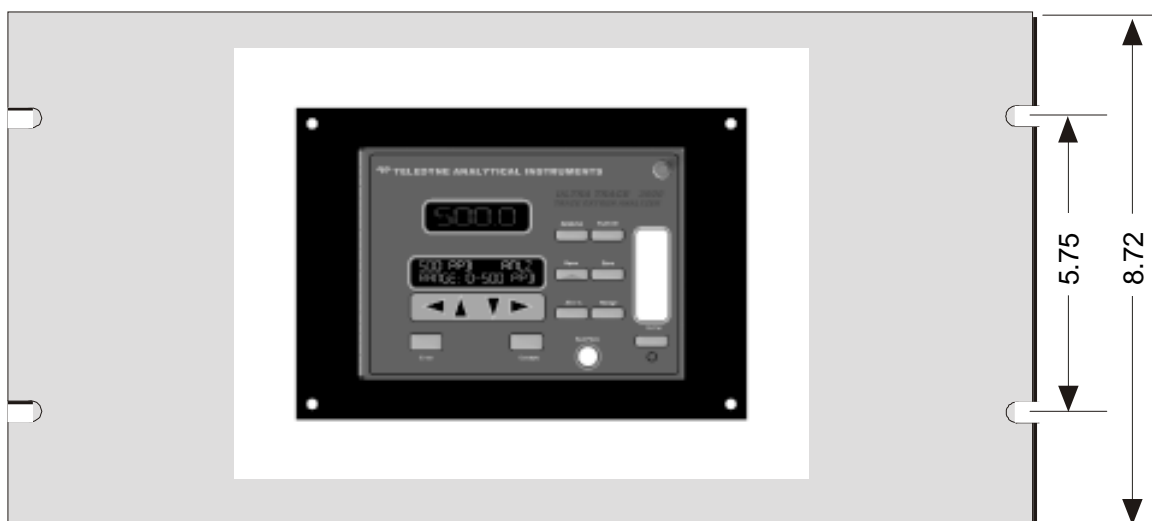
or your local representative.

### A-3 Drawing List

B-71228 Piping Diagram

### A-4 19-inch Relay Rack Panel Mount

*Figure A-1: Single 19" Rack Mounts  
(dimensions in mm)*



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## **A-5**

### **Ultra Trace 3000 SERIES ANALYZERS APPLICATION NOTES ON PRESSURES AND FLOW RECOMMENDATIONS**

3000 series analyzers require reasonably regulated sample pressures. While the 3000 analyzers are not sensitive to variations of incoming pressure (provided they are properly vented to atmospheric pressure) The pressure must be maintained as to provide a useable flow rate through the analyzer. Any line attached to sample vent should be 1/4 or larger in diameter.

#### **FLOW RATE RECOMMENDATIONS:**

A usable flow rate for a 3000 series analyzer is one which can be measured on the flowmeter. This is basically 0.5 - 2.0 SLPM. The optimum flow rate is 1 SLPM (mid scale). Note: response time is dependent on flow rate, a low flow rate will result in slow response to O<sub>2</sub> changes in the sample stream. The span flow rate should be the approximately same as the sample flow rate.

#### **CELL PRESSURE CONCERNS:**

The sensors used in 3000 series analyzers are optimized to function at atmospheric pressure. At pressures other than atmospheric the diffusion rate of O<sub>2</sub> will be different than optimum value. Higher pressures will produce faster O<sub>2</sub> diffusion rates resulting in higher O<sub>2</sub> reading and shorter cell life. To use a 3000 series analyzer at a cell pressure other than atmospheric, the analyzer must be calibrated with a known calibration gas at the new cell pressure to adjust for the different diffusion rate. Cell pressures below 2/3 atmospheric are not recommended because they tend to cause excessive internal expansion which may result in seal failure.

For operation at cell pressures other than atmospheric care must be taken not to change the sample pressure rapidly or cell damage may occur. For cell pressures above atmospheric, caution must be exercised to avoid over pressuring the cell holder.

#### **FLOW CONTROL VALVE:**

All 3000 series analyzers have a flow control device. This device is a needle valve, and serves two functions in the sample path. The first function is to limit the flow rate of the sample through the analyzer. The needle valve is chosen to operate over a specific range of pressures and provide a useable flow rate over that range.

The second function that the needle valve provides is a pressure drop. This device is selected to provide the only significant pressure drop in the sample path.

**BY-PASS:**

To improve the system response, a by-pass can be added to increase the sample flow rate to the analyzer by a factor of ten. A by-pass provides a sample flow path around the analyzer of 2 - 18 SCFH. typically.

**CONVERSIONS:**

1 PSI	=	2.04 INCHES OF MERCURY (in. Hg.)
1 SCFH	=	0.476 SLPM

**NOTE:** The MSDS on this material is available upon request through the Teledyne Environmental, Health and Safety Coordinator. Contact at (626) 934-1592